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SECOND REPORT

OF

THE COMMISSIONERS

FOR INQUIRING INTO THE

STATE OF LARGE TOWNS AND POPULOUS DISTRICTS.

Reid D B et al

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ON THE

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IN

THE NORTHERN COAL-MINE DISTRICT.

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With Remarks on some Points connected with the Health of the Inhabitants in the adjacent Mining District.

BY D. B. REID, ESQ., M.D.

IN reporting the result of the inquiry on which I entered in the North of England, my observations are directed, in the first place, to the more prominent circumstances that came under my own notice, and such explanatory remarks are added as have appeared desirable in connection with the replies received from the various Committees that were formed in the more important towns visited, with the view of forwarding the objects of the Health of Towns Commission.

Newcastle, Gateshead, Carlisle, North Shields, South Shields, Sunderland, and Durham, formed successively the leading points of investigation, and such of the more populous localities in the immediate vicinity of these towns as my time permitted me to visit.

PART I.

Remarks on the Mining Districts, more especially in reference to the Habitations of the Coal Miners, and the Atmosphere to which they are exposed.

The northern district being peculiarly distinguished by its coal-mines, the habitations of the miners necessarily attracted my attention in the first instance, and, in examining these, they were found in general to be very variously affected according to the locality in which they were placed, their proximity to the coal-pit, and the attention which appeared to have been bestowed upon them by the proprietors.

Many of the older pit-rows are placed on level ground, and where this is the case, they present not only those extreme defects from deficient drainage and cleansing that are so commonly associated with such circumstances, particularly where the ground is naturally damp, or in the vicinity of pools of water, but two other evils, exceedingly important in their influence upon the health of the inhabitants, may also be observed, viz., the action of the vitiated air from fiery heaps in the vicinity of the pits and of the pitmen's houses, and the effect of vapour where water from the steam-engine is exposed on an extensive surface with the view of cooling it, so that it may be used again for condensation.

The vitiated air from fiery heaps appears to have been considerably reduced during the last ten years, or, at all events, the examples which I saw during my recent examination did not present to me so striking an effect as I recollect to have noticed in the same districts on former occasions. The extent to which this combustion of the small coal has of late been carried, may be gathered from a passage in Dr. Buckland's recent address to the Geological Society, in which he estimates the annual consumption in this manner to have approached at times to millions of tons; and, though many miners have affirmed that this statement expresses an amount which they believe to be far beyond the actual consumption, I am still satisfied that the practice of permitting fiery heaps to burn near the pit-mouths is most injurious, and should be arrested in every case where it is practicable, even though nothing should be consumed but some inferior small coal. Hitherto the waste of coal solely has been an object of attention, but, even where that has been comparatively trifling, from the inferior nature of the material consumed, sometimes little better than a species of shale, and perhaps altogether unmarketable, a more grave consideration arises in tracing its influence on the surrounding air.

These fiery heaps produce

Carbonic acid.
Carbonic oxide.
Sulphurous acid, and occasionally sulphuretted hydrogen in smaller proportion.
Steam, and, in many cases, according to the nature of the material undergoing combustion, all the varied oleaginous, ammoniacal, and other products that may be separated by distillation at various temperatures from common coal, as the fire begins to approach upon those portions that may not hitherto have been kindled into actual combustion.

It will naturally occur that such fiery heaps are exceedingly objectionable, not only from their influence upon the habitations in their vicinity, but also on all occasions when the wind inclines towards the pit mouths, as they must then deteriorate the supply of air to the miner in the pit below. This reason alone should lead to the adoption of more effectual measures for their suppression, as the bad air from them often drifts along the surface, or is thrown into endless eddies, by which the fresh air is contaminated with it in its progress to the pit. In other places I have noticed cases where a vitiated atmosphere from a single but very large chimney could be distinctly recognised at a distance of two miles; and it is obvious that when the wind inclines continuously for a long period in one direction, so as to involve the pit mouth, or any row of pitmen's cottages in its course, it may be difficult to appreciate the magnitude of the evil that may from time to time have been produced by the large heaps of fuel sometimes on fire at a single place. I should be totally at a loss to account for their influence not being more fully appreciated, were it not proverbial how numerous are the circumstances to which habit reconciles us, when their evil effects are not clearly brought under consideration.

My attention was first directed particularly to this question on the present occasion in consequence of having met with cases where perpetual headache occurred in the vicinity of coal-pits, which the complaining parties stated continually hung upon them, except when they left the pit-row in which they suffered, and went to more elevated ground. I ascertained that even women, who never descend into the mines in the district under consideration, complained of the perpetual headache which oppressed them in the vicinity of some of the pits.

Many facts might be adduced in reference to this subject; but it is not considered necessary to enlarge upon a point which is in a great measure self-evident, and which demands more and more consideration in proportion as the combustion takes place in low and sheltered ground that retains the aerial products, and as the heap is near to the pit-mouth or the pit-rows which it may affect.

Emanations from water coolers have been represented to me as having a very offensive and distressing effect upon the atmosphere in some pit-rows, and as being accompanied by sulphureous emanations, tarnishing silver in the usual manner. I have not observed these effects personally, perhaps from my recent visit having been made in December, when the lower temperature of the atmosphere must have deprived them of much of their force.

The external ventilation of many pits and pit-rows is much affected in numerous cases by the mounds of ashes and other impurities that sometimes rise on either side of them. The passages or roads also are not unfrequently of the most imperfect description, consisting of little more than the original soil, often cut into deep ruts by carts to such an extent as to render them scarcely passable in winter.

Though many of the pitmen's houses still present the defects of site that have been enumerated, a spirit of improvement appears for some time past to have been extending in various places, and numerous pitmen's rows may be seen where the furniture, as well as the general style of accommodation, is very considerably beyond what might have been expected. Among those of this superior description which I have inspected, I may refer more particularly to some that were pointed out to me by Mr. Longridge near the Bedlington Iron Works, which presented a very marked appearance of comfort, cleanliness, and cheerfulness; and I would observe, generally, in respect to these and other pitmen's houses of a similar superior description, that the provision of good houses for the pitmen by proprietors appears to have a powerful moral effect in improving all their habits, and that the occupants of such houses generally show with an honest pride their eight-day clock and mahogany bedstead, the former being considered by the miner, in an isolated district, an indispensable requisite in timing his early labours.

Where the pit-rows receive little or no attention in respect to the means of cleansing, few classes of habitations are apt to present a more wretched appearance; and, without entering on any detailed description of them and of the strong impression which even a single visit to many of these is calculated to convey, the following statement received from Mr. Webster, of Durham, and attested by the Rev. Mr. Todd, Mr. John Prince, and Mr. Thomas Marsden, all of Shincliffe, will convey a good idea of their deficiencies in respect to cleansing and external ventilation, and of the manner in which they are viewed by those who are cognizant of their condition at all times. Such pit-rows, however objectionable in any locality, become still less tolerable in proportion to their vicinity to other habitations; and Mr. Webster informed me that fevers of a malignant character are more frequent in the village of Shincliffe than in the surrounding district. The very recent period within which these pit-rows were constructed, marks the slow progress with which improvements may be expected to become general that are not insisted on to a certain extent by compulsory measures. It is stated that

"Fifty pitmen's houses were built in the year 1842, now containing nearly 300 people, at the lower part of the village of Shincliffe, parish of St. Oswald's, Durham, on less than an acre of ground; that there are no necessaries, no cesspools, no conduits nor drains, but that the filth accumulates in the front of the houses, and that the water thrown out of them is allowed either to sink into the ground or flow on the surface into the main street. The consequence was, that this last summer the stench arising from the locality was so perceptible that it excited general observation: the space between the backs of the houses is not more than four feet, and most of the water is thrown out there, remaining in a stagnant state until evaporation takes place: there are neither pumps nor wells; and water for the use of the inhabitants is brought from the upper part of the village, generally on the heads of the women, whereas pipes might be laid down at a trifling expense. We beg leave to observe that pitmen's houses are usually built in a locality uninhabited previously; but this can be no excuse for want of cleanliness when they are built in villages where that is attended to."

Where a small plot of ground is attached to the individual cottages, and attended to by the miner or his family, it appears to contribute much to the comfort of the inmates; but the very various success that has attended the introduction of this plan in different localities indicates that, unless fostered by the care of the proprietors, for a time at least, it may be doubtful whether those good effects will be realized that have been anticipated from this cause.

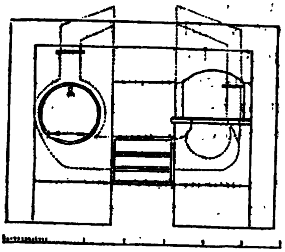
In point of internal arrangements, those cottages that have two rooms may be justly considered to present substantial accommodation for the inmates; but, even there, the most distressing scenes perpetually occur during the prevalence of disease, from the want of those conveniences that are equally essential for health and decency. There is a universal feeling that such arrangements have been too long neglected, and that nothing is more imperative than that the great majority of pit-rows should be put upon a new footing in this respect in connection with drainage and cleansing. The miners did not hesitate to state the bitterness of their wants, and the great boon which it would accord to them, were a proper consideration given to this subject. In cases of disease, more particularly among the female inmates, it was again and again represented to me that all sense of decency had to be overcome, or they were often subjected to many causes of great suffering and increased sickness.

Many of the miners complain much of the deficient accommodation in cottages, particularly where there was only one room. Such limited habitations often formed in themselves sources of great domestic misery and discomfort, and the defective discharge of vitiated air from the loft or attic, when beds are placed there, is often the cause of a comparatively oppressive and unrefreshing sleep. (See the plates.)

Cottages with three rooms are comparatively rare; but some even with four rooms may be occasionally seen. (See the plates.)

A practice is very common throughout the mining district of retaining the urine till it is decomposed and highly charged with ammonia, when it is used as a substitute for soap. This practice, by no means confined to the mining district alone, as will be observed on perusing the accompanying pages, is not uncommon in the towns, though no manufacturing operation requires its preservation, as in print works and in cloth manufactories. In the pit-rows the urine from several habitations is often collected into a common barrel from which each family is supplied on the washing day. Though represented in some cases that this course was desirable from the condition of the water used, and that the ammonia was superior to soap, I could not convince myself that the practice was not adhered to from former habits, and a view to economy rather than from any other cause: it appeared to me one, however, which is more common in the mining district now under consideration than in any other part of the kingdom where I have had the opportunity of examining as minutely into the habitations of the poor, and where the urine is not collected for manufacturing purposes, but for private use in families. Where this practice continues, the state of the atmosphere on washing days is altogether unaccountable to those who are not aware of the cause.

The comparative economy of fuel in the coal-mining districts leads necessarily to a peculiar feature in the habitations of the miner, viz., the abundant warmth which they receive from the ample fires that are very generally sustained, and the extent to which they expel moisture and maintain a constant ventilation. This ventilation is also peculiarly effective in numerous instances from the construction of the fire-place, as the altitude which the chimney attains before it is enclosed in the walls enables it to drain off the air of the apartment at a higher level than is commonly observed in cottages, while the power of the fire sustains a strong draught in the chimney. The fire also, not being generally extinguished at night, contributes much to improve the ventilation; though backward currents injurious to health must at times ensue, still, on the whole, the warmth of the chimney, even when the fire may have declined much, commonly sustains an ascending current of air, if the fittings at the doors and windows be not so close as to prevent the ingress of a sufficient supply.



The annexed figure shows a form of fire-place very common in the mining districts, and also in the rural cottages in the same localities, the ordinary fire-place being made to act from time to time on a boiler on one side, or on an oven on the other, according to the manner in which the slides, valves, or dampers are regulated. It presents perhaps the principal peculiarity in many cottages and fire-places in the north of England, and, though it has evidently formed the basis of numerous improvements in fire-places, it is an object of attention more from the effects on health that are consequent on the large amount of fuel it consumes than a good pattern for imitation, especially where coal is expensive.

In visiting some pit-rows at periods when the miner was at home, the care-worn figure of the miner, his pallid countenance and shrivelled aspect, often presented a painful contrast with that of other members of his family not engaged in the mine, particularly his female relatives of the same period of life: this, perhaps, presents one of the surest indications of the extent to which his health is affected in mines where offensive gases pre-eminently prevail. On putting to a group of such miners some questions connected with their health, one of the men emphatically replied, "Look at us, and you will see whether our health is affected or not;" and, certainly, out of the whole number (eight or ten were accidentally congregated together) there was not one whose appearance did not indicate the effects arising from the long-continued influence of a vitiated atmosphere. And, though I do not profess to enter upon details in this report as to the ventilation of mines, the following summary founded on observations made in coal-mines on the present and former occasions, appears to me to be requisite, in order to bring the question of the health of the miners more specifically under consideration, and indicates the extreme importance in his case that the air of his cottage should be freed as much as possible from the evil influence of defective drainage and cleansing, and other causes of inferior ventilation,—that he may at least sleep in a pure atmosphere, as the state of that in which his duties connected with the peculiar circumstances of the mine leads him to work, is often of the most inferior description.

A. The atmosphere that supplies the pit-mouth is not always sufficiently protected from the products of combustion that arise from the fiery heap in its vicinity, which is still permitted at numerous pits. (See plates.)

B. The absolute amount of fresh air led into individual coal mines appears to me to be generally insufficient for the support of health; and, though the miner cannot expect to obtain below ground an atmosphere such as can be commanded above, still the length of the air-courses, extending many miles without a particle of fresh air entering, except at a single aperture, its progressive deterioration, the amount of impurity it attains long before its escape, and the emanations from the goaves, which are immense reservoirs, in general of fire-damp, or other impurities, as well as the explosions that ensue from time to time, all attest the great importance of the details of these circumstances being more minutely ascertained and recorded, with a view to improvement, than is practicable under present arrangements.

C. The separation of the downcast and upcast movement of air (the former supplying the mine, and the latter withdrawing the vitiated air from it), when they are affected by a partition or brattice dividing one shaft into two, admits in most cases of a more effective isolation, which would tend to diminish the chances of contaminating the fresh air with a portion of the ascending current of vitiated air. (See plates). The expense of an effective brattice in some shafts amounts to nearly 1000*l.*; and, as it is made of wood, the heat, moisture, and bad air render it exceedingly prone to decay, and then the good air leaks to a greater or less extent at once from the downcast to the upcast shaft without passing through the mine. The introduction of purer air-tight brattices both in the shaft and in the workings, and the use of materials, as the muriate of zinc (Sir William Burnett's patent) to prevent decomposition, would assist much in sustaining a better atmosphere.

D. The large corfe or coal-basket in some pits fills so entirely the area of the shaft, that the ventilation may be considered in a great measure as practically suspended during its descent.

E. The current that supplies the miner when actually at work in the coal-seam, reaching the main channel too often only by a secondary or tertiary branch from the main current, he may pass his time in an atmosphere even inferior to that which ascends the vitiated air-shaft, the latter being diluted with air of a purer quality that may have passed through more leading channels. (See plates.)

F. Notwithstanding this, no means are employed at present for estimating the amount of carbonic acid in the atmosphere of coal-mines: its effects, perhaps, are more extensively destructive to human life, though it does not operate with those circumstances and that rapidity which gives such notoriety to accidents arising from explosive mixtures of carburetted hydrogen and common air.

G. The miner who works near the downcast shaft obtains always comparatively good air, while he who works near the upcast shaft is continually exposed to vitiated air.

H. In explosive or other dangerous atmospheres where carburetted hydrogen abounds, it appears to me that more attention should be given to Dr. Clanny's improved lamp, in which he has introduced the use of Sir Humphry Davy's wire-gauze. In the Davy lamp the heat accumulates principally above on ordinary occasions, and in a current the flame and sparks from the wick are prone to strike upon the wire-gauze and inflame any coal-dust or other inflammable matter that may be without. In the improved Clanny lamp the flame is sustained comparatively upright both in a calm and in a current, and it appears doubtful whether a drop of water or any mechanical violence would injure it more than the Davy lamp; for the cylinder that surrounds the flame is not made of gauze, but of glass sufficiently strong to bear as great a blow as the gauze without injury: mica may be substituted, if necessary, for the glass. I have seen the glass cylinder at different times plunged into cold water without breaking, the lamp having previously been in full combustion for half an hour or an hour. Dr. Clanny was the first person who entered a field of explosive air in a mine with a safety lamp, and this laid the basis of future discoveries in this important investigation; and, having seen the Davy lamp blown out in a current in a mine in which the Clanny lamp was scarcely at all affected, and having subsequently examined Dr. Clanny's lamp in detail, I am well satisfied that neither his original claims nor the value of his present lamp are sufficiently appreciated. No lamp, however, even were it absolutely safe, can protect the miner from the respiration of a vitiated atmosphere. Extended ventilation can alone effect this important object.

I. No conveniences are made for the miners, and hence the atmosphere is more or less contaminated from this cause; and local accumulations, particularly where the trap-boys attend the doors, have been represented to me to produce at times sickness and loss of appetite among the men.

J. Carbonic acid, carburetted hydrogen, and animal exhalations, not only induce oppression to such an extent in many places as to diminish very materially the effective value of any man's services and lay the foundation of permanent disease, but, in badly ventilated mines, the condition of the inferior animals is also affected, and cases of glanders among the horses and cancer among the mice that infest some mines have been reported to me.

Though the arduous nature of mining enterprises necessarily prevents the possibility of that pure atmosphere being supplied which may be commanded in other places, no field perhaps presents such opportunities for improvement, or so imperiously calls for that inspection and regulation which has produced equally beneficial effects in schools, manufactories, hospitals, prisons, and other places.

In the case of coal-mines, it appears to me desirable not only that a system of inspection, which has frequently been recommended, should be carried out, but that it should also be accompanied by a code of rules for the education and training of viewers, such as must necessarily extend the processes and appliances for the ventilation of mines in proportion to the increasing danger to which the miner is exposed, and the deteriorating influence of the more vitiated atmosphere which the use of the Davy lamp enables him to penetrate. It is impossible to visit any mine almost without observing that a large number of those to whom the more immediate inspection is intrusted, have not had the opportunity of obtaining that knowledge of science which persons holding their arduous and responsible offices should possess.

I have had no hesitation in coming to the conclusions embodied in the preceding statements, relying on the examination made not only on the present occasion but also at a former period when visiting various pits, having traversed one of the most fiery pits at Wallsend not long before the explosion took place there, by which upwards of 100 lives were lost. A reference to the plates will point out the localities in which the amount of carbonic acid in the air in the pit was tested by such means as I could apply on the spot, and indicate the circumstances under which a mine that is often said to be healthy or amply ventilated may still be so managed as to subject the men to a very impure atmosphere in those places in which they may be actually engaged at work.

As to the health of the pitmen generally, excluding the results of accidents, I am certainly disposed to consider that they suffer more from the vitiated atmosphere which they breathe than is generally admitted: this opinion is founded on what I have seen, as well as from the examination of the state of the air in mines. The warmth and comparative equality of temperature in mines reduces, to a certain extent, the evils to which the men are subjected. I have been unable hitherto to obtain such an amount of information as would afford satisfactory tables on this point. Many miners live to a considerable age, and for the materials from which the following table is compiled I am indebted to Mr. Wilkinson, of Newcastle, who extracted the causes of death of 100 pitmen in the order in which they occurred in the Register

Tables at Wallsend. In presenting it I am by no means disposed to consider that it can be relied on as a true exposition of the average causes of death among miners, except in the locality to which it refers; but, on the other hand, in the absence of other information, it will show that any advantage from equality of temperature in the mine is not such as to overbalance other circumstances that tend largely to affect the organs of respiration. The age at death was also stated to me, but there was not sufficient collateral information to enable me to place this part of the subject on that basis which would have admitted of a just and accurate comparison.

TABLE showing the CAUSES of DEATH among 100 PITMEN, as extracted from the Registrar's Report for the District at Wallsend.

Affection of the brain	1	Gravel	1
Ague	1	Inflammation (?)	1
Apoplexy	1	——— of the bowels	5
Asthma	4	——— ,, brain	1
Asthma and debility	1	——— ,, chest	1
Asthma, or old age	1	Malignant sore throat	1
Asthma and gravel	1	Old age	13
Brain fever	1	Paralysis	1
Cancer in the lip 1; in the face 1;	2	Paralytic Stroke	1
Cholera	1	Stomach complaint	1
Consumption	25	Small-pox	1
Convulsive fits	2	Spitting of blood	1
Debility	7	Typhus fever	5
Disease of the prostate gland	1	Ulcer in throat	1
Disease of the heart	2	Visitation of God	1
Dropsy	13		
Intoxication	1	Total	100

The transition from the mine to the external atmosphere, and from the external atmosphere to the mine, especially in winter, indicates the importance of those comforts and conveniences for enabling the miner to wash himself, and to warm and dry his clothes when he may have been subjected to a long continued dripping of water, or other causes of dampness, engaging a much more careful attention at the pit mouth than they have generally done in this country,—particularly as very simple and economical arrangements, where the cost of fuel can be no object, would prove a source of very great comfort to the men.

As to other mines, the comparatively small number of the population engaged in them, and the absence of fire-damp, as well as their comparative remoteness from those towns which formed the principal object of attention, prevented me from having the opportunity of examining circumstances with that detail which would permit me at present to offer many observations with confidence in respect to them; but the extreme condition to which numbers are annually reduced who attend more especially to some of the operations of the smelting-houses attached to the lead-works, and particularly those who are engaged in cleaning out the smoke-flues that are largely charged with the oxide of lead, points out the importance of efforts being made to control the effects that are produced in various operations with this metal, and of the adaptation as a substitute for flues of some plan of condensation, such as is adverted to in the section on nuisances, and illustrated n the plates.

In concluding this part, it is necessary for me to remark, that there appeared to me to be in all places visited an increasing conviction as to the importance of the more extended ventilation of coal-mines; and while my impression as to the defective position in which this question stands is freely stated, I must also state that there are able men in the mining districts who are well satisfied of this fact. I may refer to the Report of the South Shields Committee on Accidents in Mines, written by Mr. Mather, not only in evidence of the local attention given to this subject, but also as showing how very carefully and practically it has been investigated.

PART II.

General Report on the Towns visited in the Northern Districts.

PRELIMINARY REMARKS.

THE towns and villages visited in the northern district present abundant evidence of the causes of that high rate of mortality which the mortuary registers evince. Leading streets in some of the principal towns, and those situated in the highest ground, and occupied by the more wealthy inhabitants, may present a comparatively favourable aspect; but, in general, on turning aside into the lanes, courts, and alleys frequented by the poorer part of the population, the condition of their habitations indicates the accumulated influence of evils that must have been progressively increasing for a long period, and augmenting with the density of the population.

The precise extent to which these are, and may have been, dependent on poverty, defective laws, the defective enforcement of such as have been enacted, or on ignorance, dissipation, and vice, it may be impossible to estimate; but, certainly, the result of all inquiries in which I have been engaged has only given additional strength to the conviction that a vast amount of misery, disease, poverty, and death may be prevented by the introduction of suitable sanatory regulations, with the view of controlling admitted and remediable evils. They operate in too many cases as powerfully in lowering the tone of moral feeling as they are successful in destroying health, strength, and life among the labouring population. Habitations for families, destitute alike of adequate accommodation for the separation of the sexes, and even of those conveniences which common decency requires, the absence of a sufficient and easily accessible supply of wholesome water, and the utter inefficiency of the means resorted to for cleansing, drainage, and sewerage, are evils that press heavily upon a large number of the humbler classes in every one of the towns to which I have to refer; and though I cannot affirm that on the whole the districts examined presented more offensive scenes than have been traced in the metropolis or other places, still they offered nothing, when viewed generally, which can entitle them to claim a higher rank in this respect; and when the favourable inclinations which the most of them have for drainage, however defective the soil may be, are taken into consideration, and the rivers which run by them, few places could be selected that would show more prominently how utterly inadequate the present arrangements have been for sanatory purposes, even in those towns whose natural position has rendered them the least obnoxious to the evils under which they suffer. It cannot be expected that manufacturing towns, abounding in a population accustomed to severe and arduous labour, not in any way favourable to personal cleanliness, can exhibit a similar aspect to villages that are purely agricultural, or whose principal inhabitants are engaged for the most part in literary and academic pursuits. In places, however, where one or two thousand tons of refuse may remain within the town itself, or on its very verge, (as may be seen in more than one of the towns now under consideration,) for months without removal,—where there are habitations with a whole apartment, and sometimes a floor, appropriated to refuse, the emanations from which penetrate into every room, it cannot be too much to affirm that they nourish the seeds of those diseases that prevail in their vicinity, and unquestionably form a powerful, if not the principal, element in the annual mortality of their respective districts.

Though many of those in official situations, whose professional duties or the dictates of humanity led them to be minutely acquainted with the humblest habitations, were aware of the extent of evils that prevailed in individual towns and villages, cases constantly occurred that assured me that the greater mass of the inhabitants were often not practically conversant with the extent to which disease and suffering existed even in their own neighbourhood. I have been accompanied at times to scenes by persons who might have been supposed to have been well acquainted with the abodes of the poor in the places to which they invited my attention as extreme specimens, and as exhibiting the most severe cases of destitution and disease, when I have had to state that the parties appeared to me to be comparatively comfortable, and in a very different position from others I had previously seen with medical gentlemen, or with the assistance of the relieving officers, or the superintendent of the police. At local public meetings also, held in connection with the objects of the Commission, examples were not wanting where, though there was no unfair anxiety to evince the superior condition of the population under examination, the statements made clearly indicated that there were numbers who had only a vague and imperfect knowledge of the true condition of the humblest habitations around them from a deficiency of personal observation, and many instances occurred where there was good reason to believe that very beneficial effects arose from the investigations that afterwards ensued. I am desirous of representing this fact in the strongest terms in which I may be permitted to express it, having a firm assurance from what I have universally observed in this district, that a thorough and distinct exposition of the realities of that amount of discomfort, disease, and death, that are justly attributable to causes that may be easily reduced in virulence, though they may not be so rapidly removed effectually, will lead numbers to assist in the amelioration of the condition of the poor as they become more sensibly alive to the great benefits that arise from a little timely assistance or interference, and to the magnitude of those evils that oppress so many of our fellow-creatures, and to which millions are habitually exposed, without that consciousness of their existence which is essential for the development and prosecution of active measures of relief.

Numerous cases presented themselves which indicated that the extreme condition of many habitations among the poorest classes of society, and the accumulation of masses of the most disgusting filth in narrow passages, scarcely allowing in the most extreme cases one person to pass comfortably, tend greatly to reduce such communication as ensues between their inmates and those in a better position who may have any dealings or intercourse with them, increasing thereby that isolation to which they are too much subject, and leading often to habits of recklessness and indifference to an extent that is never observed where families are subject even to little or nothing more than the casual inspection of others in a different rank of life. I should omit one of the most important circumstances which was repeatedly forced upon my attention by different individuals in the northern district, did I not state my conviction that a more extensive system of organization among those who have the disposition to devote a portion of their time to their poorer brethren would be productive of incalculable benefits to them in each individual district.

But, if it be true that there are evils of great magnitude affecting society as extensively perhaps in some parts in this district as any others, which only require to be seen to be understood and appreciated, there are others, as ventilation, which have been made more manifest in modern times, a knowledge of which is less familiar, though, on the whole, the general information on this subject in the northern district is rather in advance of what is observed in other places, from the attention it engages in the coal mines. Ventilation is rarely understood or applied in dwelling-houses to that extent or with that care and precision which health and safety require. In particular, sleep is rendered comparatively unrefreshing from the want of a sufficient supply of pure air. The accurate and precise workmanship of modern architecture, and the enterprise of mining adventure and manufacturing operations have advanced in a greater ratio than the general knowledge of the precautions essential for the due supply of atmospheric air; and amidst the endless examples of this fact which came under my immediate notice in the northern district, and which I could adduce here, I shall confine myself to the following, as exhibiting in a practical manner the extent of evil that may arise simply from want of information on points which many suppose would have been almost universally understood, but which in reality are only imperfectly appreciated in practice even where general principles are familiarly known.

It was stated to me in one place that fire purifies air; and great surprise was manifested on pointing out the increased impurity that was communicated to air respired habitually in the case referred to, when the products of combustion mingled with it, and the sure and certain influence it would ultimately exert on the health of the men exposed to it. This occurred in an individual who had several hundred men under his charge, though only a few of them were exposed continuously to the atmosphere under consideration; and minute inquiries satisfied me that under the circumstances in which he had attained his position and the absence of all proper opportunities of precise information, as well as the usages to which he was accustomed, nothing else could have been anticipated. In a church in another district, where the taste of the atmosphere was so sharp and pungent that I immediately remarked the circumstance to the attendant, he told me that it was merely "some stythe" from the furnace or fire-place by which it was heated, and to which he did not appear to attach any importance. I do not consider, from the specimen of air I tasted, that, if the atmosphere in the church referred to is often in a similar condition to that now mentioned, the congregation can be free from headache and oppression, even were considerable ventilation sustained; but this did not appear to be the case.

Lastly, schools came under my notice where the vitiated air from one school formed the only supply to another school which was placed above it.

The continued attacks of fever in the same localities, and the occurrence even of the cholera in the same places where fever is most frequently noticed, has not been sufficient to arouse the attention of the inhabitants generally to the importance of the local authorities insisting on the removal of those massive accumulations of decomposing refuse which are ready again to pour out their virulence on the surrounding habitations, wherever similar combinations of atmospheric phenomena and other causes shall unite their evil influence. As an example of one of these, I may refer to the condition of Bankwell-stairs, a court connected with Pipewell-gate, one of the worst districts in Gateshead, a town in which the progress of the cholera was excessively rapid. Dr. Clanny, in one of his valuable publications on the cholera, states at page 5—

> "At Gateshead the disease did not make its apparance till the 25th of December, when only two cases were, on the evening of that day, reported; and so rapid was the course of 'the pestilence that walketh in darkness,' that on the 27th of December, 172 patients were reported, of whom 63 had died. In a few days afterwards we find at Newcastle, where the disease had not been heretofore so fatally rapid in its progress, that it renewed its attacks with greater energy than ever."

Dr. Clanny also observes, in respect to Sunderland,—

> "From attentive observation, I am satisfied that those parts of Sunderland in which the disease prevailed most extensively were the very places in which typhus fever had formerly prevailed to the greatest extent, and which an experienced medical visitor would fix upon as most likely for contagious diseases to make their commencement."

I have been informed that orders have been recently issued for the removal of the refuse at Bankwell-stairs, and certainly no step was more imperiously demanded. The sallow aspect of those of the inhabitants whom I saw, and the extent to which offensive emanations from it penetrated into every dwelling around, could scarcely be credited except by those who have personally inspected such places.

The general appearance of the population, in the habitations of the poorest classes in the district under consideration, certainly impressed me with the conviction, that it corresponded with the indications of the mortality tables; and the varied rates of mortality in different parts of the same town might to a certain extent have been anticipated almost in many places by a stranger, from the condition of the habitations and the streets in which they were situated, or the nuisances in their immediate vicinity.

A very natural anxiety was expressed in almost every place visited as to the general impression made by the appearance of the population, and the condition of the habitations of the poorer classes. There was universally a frank avowal of their true condition. But questions were proposed at the same time, in endless variety, which indicated in most places that, however bad things might be, they were considered to be worse elsewhere; and thus many were insensibly led rather to congratulate themselves on their own district or town not being so bad as that of their neighbours, than to test themselves by a proper standard of comparison such as might be justly applicable to the peculiar circumstances of the case.

If we look to other places, including London, ample materials for comparison undoubtedly appear; and, even in those districts where at first a better state of arrangements might be supposed to exist, the most superficial examination too often discloses startling evidence of the want of sanatory regulations. If we take an example from Kensington, we shall find near the high road 200 families—comprising about 800 individuals—living in buildings totally unprovided with drainage or sewerage: the only accommodation consists of three privies, and a single dust-bin exposed under circumstances that render them a most disgusting nuisance to the whole neighbourhood: or, if we look to the potteries on the other side of Notting Hill, a series of ponds may be observed subject to no drainage, loaded with the most offensive animal and vegetable *débris*, and near them an open ditch, of great length and breadth, communicating with an open sewer at one end, and presenting a mass of fetid exhalations such as I have not seen exceeded in any part of the kingdom. These extreme and deplorable exhibitions, in immediate contact almost with the dwellings constructed there, were pointed out to me by the Venerable Archdeacon Sinclair, who has been directing attention to the influence which they have on the inhabitants in their vicinity, though the magnitude of the evil is such that it cannot be expected to be effectively remedied except by legislative enactments. But the existence of such a state of things in London or other places does not lessen the importance of removing similar evils in any district, and, while the knowledge of the almost universal prevalence of evils of great magnitude in other localities has not unfrequently led many to look with less aversion on those in their own neighbourhood, and consequently to be less acquainted with their nature and extent, every indication was given of an earnest anxiety to enter upon a course of improvement, more especially as the progress of the inquiry explained more fully the nature and magnitude of the evils that arise from defective sanatory regulations.

It certainly did again and again occur to me during the progress of my visits, that much good would be effected, were more accurate opinions extensively disseminated as to a more correct standard of health and longevity than appears generally to prevail at present. A reduction in the excess in the annual rate of mortality in any town or populous district, beyond the average for all England, was too often considered a satisfactory measure of the amount of that improvement which may be justly anticipated when sanatory measures assume a systematic form. Without entering into the question of that standard of health which most correctly expresses the true average condition of any country in this respect, it may be assumed that there is not at present any proper standard of health in any community to which we can appeal as an example of what we should desire to attain. Were a fair opportunity given to the human frame for that full and gradual development of which it is susceptible when nourished from infancy in a pure atmosphere, and protected alike from the effects of over excitement or the injurious results of evils of an opposite tendency, there is good reason to believe that, with the knowledge of the present day, the human frame would acquire a power approaching more nearly to the long life of ancient days when mankind attained those ages which are so rarely met with in modern times, as to form extreme exceptions to the general rule. There is still, however, much unwillingness in many to look at this subject with the full light that the progress of physical science has now cast upon it; but, fortunately, facts are too precise to permit of its being treated otherwise than as a matter of demonstration by those who take the trouble of entering minutely upon this question. Viewed accordingly under such impressions, the mortality, or rather the average age of those who die, presents an enormity of suffering and premature death, with the concomitant evils of a necessarily junior, or inexperienced population, which operates most perniciously on society.

A very high standard of health may require generations for its full development; but that is only a more pressing reason for the question being viewed correctly, and in the most practical manner of which it is susceptible, in connection with the progressive improvements which art and science render subservient to the amelioration of health.

Another very frequent remark in the towns visited in the northern district, and perhaps almost universal, was that the more extreme cases of sickness and death took place in general among a migratory portion of the population, or at all events among strangers who had come from a distance and located themselves in their present abodes. Whatever may be the point of view under which this is considered, it does not alter the fact of the extreme condition of the population within the jurisdiction of the authorities: the evil is not the less real, either in its pressure upon society, or in the individual locality in which it ensues, and should accordingly demand as much, or perhaps even more attention in the application of preventive measures, than would be requisite among those accustomed to the locality, and more largely in communication with the inhabitants than strangers. The amount of disease conveyed from place to place through the medium of the lowest class of lodging-houses, cannot be expected seriously to affect the population of large towns, unless circumstances be favourable to its extension, a condition that must always ensue where the drainage and cleansing are not placed on a proper footing. The unquestionable fact, however, that the most extreme disease is often found among such portions of the population of towns and cities, forms an important element in considering the regulations to which they should be subjected, and that introduction of disease of which they have so often been proved to be the source.

In the progress of the inquiry made in the northern districts, Dr. Fyfe of Sunderland stated to me that among his pauper patients numerous cases presented themselves which he attributed essentially to distress and disease arising from want of proper nourishment. Many cases of great individual wretchedness and poverty necessarily presented themselves in the various places visited; but, in Carlisle, the appearance of the children in the schools for the education of the poorer classes more especially arrested my attention, and impressed me with the conviction that numbers of the young pupils suffered from a low state of vitality arising from a deficiency of food. On inquiring into the circumstance, I was informed that great distress had existed among a large portion of the working population, and that in 1842 a very considerable number of the poorer inhabitants (about 6000, including men, women, and children) had only about twopence per day for their subsistence: with this exception, I saw nothing special to record beyond what may be observed in other places.

The use of opium, so far as I was informed, did not appear to have been so generally introduced as in many other districts; but different individuals stated to me that it was employed as a draught, exclusive of its use in cases of disease, even among children, both in the towns and in the mining districts.

Few circumstances were more frequently pressed upon my notice than the want of opportunities for recreation among those whose sedentary occupations, or continued labour in manufacturing operations, necessarily exposed them much to a vitiated atmosphere. It was again and again stated to me that, next to the improvement of the habitations of the poorer classes, and the introduction of proper arrangements for paving, cleansing, drainage, sewerage, the supply of water, and ventilation, no measure would be of more importance to the public health than the encouragement of such means of recreation as would afford both fresh air and exercise, particularly to the junior population, and the institution of public games, museums, or other opportunities, that would afford some inducement to the labourer to spend such time and means with his wife and family as he, in many cases, squanders alone. The improvement of his dwelling, it was universally agreed, must form the basis of diminishing that disruption of social intercourse and that destruction of health and strength which attend the dissipation of the ale-house. To the attractions of the latter, and the repulsion of their own habitations, which too often isolate the heads of families, (causes such as no doubt operate, perhaps universally in other places), the extreme condition of many dwellings in the northern district may be attributed, as well as that train of attendant evils by which such habits are accompanied. In particular, they necessarily produce discordant tastes and habits as well as consume the means that might render many a habitation cheerful and happy; but, were proper sources of recreation provided, and athletic sports or games instituted for the junior part of the population, it is impossible, perhaps, to estimate the extent to which, in process of time, such measures might unite many members of families who at present are in a great measure separated. It was also strongly urged that any measure that would assist in drawing out the poor from their abodes would have an ameliorating effect both upon their health and character, as nothing tends more to a downward course than the continued and unbroken observation of depressing scenes in a depressing atmosphere, which, though it may be repugnant at one time, becomes eventually too habitual to attract further notice.

In reporting such observations, with which I fully concurred, it must be stated that, in the mining district generally, including the principal towns, the working classes appeared to me to be both sober and industrious; but still it is impossible for any one who has examined minutely the manner in which the working man's after-hours are spent, not to perceive how important the influence of such measures would be along with the improvement of his habitation.

The higher tone of health, and greater length of years, observed in all those classes whose position and circumstances elevated them above the severity of extreme labour, and relieved them from a distressing and harassing anxiety as to their supplies with the necessities of daily life, pointed naturally to a superior standard that may be more or less attainable in each peculiar district; but, so far as I may judge from the districts visited, they form no exception to the general rule, that the extent to which the value of human life is reduced below this standard is still imperfectly appreciated by the great mass of the community, nor can a reasonable expectation be entertained that this reduction will be diminished to that marked degree which appears to be abundantly practicable, till the people themselves shall become more informed as to the precise nature and influence of the evils under which they suffer, and more sensibly alive to the great extent to which they may be moderated by a practical knowledge which it is in their own power to apply, the success of which is evinced in endless examples wherever any effort has been made to apply them.

Though there is no systematic survey in any of the towns of the northern district, either for drainage or other purposes, the importance of this subject had already forced itself upon the attention of many of the inhabitants; and I refer to it here principally with the view of stating that, independent of its necessity for different public works, it appeared to be equally demanded as the only certain means of preserving from encroachment common lands and other public property, as well as of securing those privileges or rights of way which have been obstructed in many places without any proper authority. In one place at Newcastle, if the information given me was correct, no less than ten avenues to the river had been closed up within the recollection of some of the inhabitants, and great discomfort and inconvenience were thus entailed upon those who lived in the vicinity of these approaches. By closing them not only was the natural ventilation obstructed, but the inhabitants in the vicinity were prevented from obtaining so readily that supply of water which the river affords, and deprived of many other collateral advantages.

In Sunderland various communications of a similar nature were made to me, and it was also stated that many parties took materials from Building Hill (a rising ground near the centre of the town), who were not entitled to remove them. Should this very valuable site be appropriated for public recreation, as is contemplated at present, it would be an object rather to arrest the process of demolition now in progress than to accelerate the destruction of the remainder of the

Hill; by the latitude which is now exercised in removing the materials of which it is composed.

In North Shields, it was stated to me, that the public had acquired, or possessed, rights of way which the Commissioners of Improvements did not acknowledge.

In Gateshead, the corporation contend that a portion of ground called the Windmill Hill, containing about 10 acres, and adjoining the town of Gateshead, belongs to the public, though the present boroughholders and freemen claim it as their own private property, and have built several houses on it.

DISPOSITION OF STREETS AND BUILDINGS.

The want of proper enactments and their due enforcement is abundantly conspicuous in the disposition of streets and buildings in the towns of the northern district; at the same time, it must be admitted that many of the defective arrangements in this respect are connected with the history of former times, when space was still more valuable, in one point of view, than it is at present, and when walls confined the area for building and crowded the population to a great degree beyond that would otherwise have ensued, while the comparatively small size as well as number of the vehicles in use rendered narrow lanes and alleys of less consequence than they are at present. In the older portions of Newcastle, Gateshead, North Shields, and South Shields, the opening of the streets, lanes, and alleys in the worst districts would prove of incalculable benefit: many of them are more or less inaccessible except by narrow stairs, dark passages, and lanes (or chares as they are termed in Newcastle), some of which are little more than 3 feet wide, though the average width is 7 or 8 feet. Dwellings in such places must have been highly objectionable even when enjoying all the advantages which the wealth and consideration of their former occupants secured; but, when tenanted by the humblest classes, struggling too often under the accumulated influences of poverty, disease, and vice, they present scenes which call for the most vigorous efforts of improvement, and none perhaps would be more advantageous, among the many suggestions offered and the varied measures that must be introduced to meet individual evils, than intersecting them by thoroughfares which would render them more accessible to currents of air, and facilitate measures for drainage and cleansing.

Remarkable instances were pointed out to me of the extreme stagnation of air in some of these districts, notwithstanding the declivity of many of the stairs; and places were also shown which, though kept comparatively clean, were still subject to much disease from their proximity to localities where external ventilation was impeded, and in which few symptoms of cleanliness could be perceived.

New streets are generally very much wider than the greater number of those of ancient date, and a spirit of improvement has evidently everywhere become manifest in the anxiety which is evinced to place them on the most desirable footing. This tendency, however, when not developed in central situations where the public attention is riveted upon the spot, or where the wealth and intelligence of the proprietors enable them to secure advantages that could not otherwise be commanded, is so thwarted by the absence of proper regulations for paving, draining, cleansing, and a proper supply of water, that the most lamentable exhibitions, in these respects, are frequently presented.

A minute examination of the state of the air in many of the lanes, courts, and alleys has assured me that the general impression against them is rather under than over rated. Even in windy weather they are much exposed, according to their situation and the duration of the current, to the influence of vitiated air blown from the chimney-tops, which accumulates wherever there is the least resistance, its ordinary tendency to ascend being counteracted by the mechanical action of the air, in the manner illustrated in the plates; but, in calm weather, they may be more justly compared to wells filled with noxious emanations, any lower aperture or passage way being, in numerous instances, too small to admit of such a movement as would maintain the comparative freshness and purity of atmosphere which is secured by a wide and open street.

In the Valley of the Tyne, the importance of opening courts and alleys becomes still more conspicuous when the progress of the vitiated air from manufactories is traced, as a wind sweeping over it may beat down ascending impurities and leave the atmosphere below loaded with smoke, exhalations from manufactories, and other offensive ingredients. A figure in the Plates represents this condition of the Valley of the Tyne, which has repeatedly forced itself upon my attention. The stagnation is not so great as in Manchester, where the town may be said to lie in a hollow. Its condition appears to be rather intermediate between that observed there and the freer movement of air which ensues in such towns as Edinburgh and Stockholm, where the lofty position of the houses, and the broken character of the ridges on which they are built, allow the most perfect freedom of escape on every side. Nor was it uncommon in the Valley of the Tyne to observe a current sweeping at a considerable elevation from side to side, while a lower current at right angles to it conveyed the atmosphere of the valley downwards towards the sea, but increased greatly the amount of smoke in the lower parts of some the towns, particularly of Newcastle-on-Tyne.

PAVING, CLEANSING, DRAINAGE, AND SEWERAGE.

The general condition of the paving, cleansing, drainage, and sewerage in the various towns in the northern district is, on the whole, of the same inferior description that prevails in most other towns, if we except the paving of the leading streets in the larger towns.

Many new streets and thoroughfares without the limits of the borough, more particularly in Newcastle and Gateshead, are wholly destitute of paving, and in a very dangerous state.

Innumerable lanes, courts, and alleys are paved in the most imperfect manner, and discharge by open water-courses accumulated liquid impurities upon the pavement in the more public streets, where a very trifling expense would have conveyed them under the pavement, and reduced greatly the offensive manner in which they at present extend over the surface.

Many of the smaller lanes never appear to become dry; the want of light and air, particularly where the direct rays of the sun have never penetrated, leaving them under additional disadvantages. They exemplify strongly the consequences that almost invariably ensue in such places where no systematic cleansing is enforced, and where the want of space altogether excludes or prevents the free access of a common cart.

Private lanes and alleys are not subject to the jurisdiction that controls public thoroughfares; and numerous streets in some towns are in a similar position in consequence of being beyond the boundaries over which the power of the local authorities extends.

The extent to which these defects in paving and cleansing prevail in different towns is, as might be expected, very various. Even new streets are subject to no regulations such as are essentially required to meet the wants of the increasing population. In no place were complaints so urgent in respect to the condition even of some of the new streets as at Newcastle. It was stated to me that "at this very moment some of the new streets of Newcastle and Gateshead are fast becoming as bad as the very worst parts of the old." Some of the streets were described as "that mass of filth that constitutes the street." It was also mentioned in respect to streets without pavement that the rain, instead of cleansing, renders "the road impassable, and the cast-out refuse, sodden in the mud, becomes more noxious than before."*

It affords no incorrect description to state that the streets most densely populated by the humbler classes, in Newcastle, Gateshead, North Shields, and South Shields, run along the banks of the river Tyne at the bottom of a very steep ascent, which is crowded with dwellings, and intersected with numerous lanes and alleys; that in many places in these streets the paving is very imperfect, and receives the accumulated liquid refuse discharged from the steep banks which keeps them to a greater or less degree in a perpetual state of impurity and offence (the facilities for drainage afforded by the declivity of the ground are thus lost, and the evils are concentrated in one spot); that they are destitute of effective arrangements for drainage, sewerage, or cleansing, and that the outpourings of the chares, lanes, courts, and alleys, are of the most offensive description, and pre-eminently contribute to the production of fever and other diseases. A few public necessaries have been erected in some places, but their number is totally inadequate to meet the wants of the working classes; and the general absence of closets or privies in connection with the habitations multiplies greatly the intensity of the evils that prevail in these localities.

Some of the public depôts for refuse within the jurisdiction of the authorities are very large. In one of these at Newcastle the accumulation increases, at times, to 1000 or 2000 tons, which is removed only once or twice a-year. In some of the private courts I have noticed accumulations amounting occasionally to 20 or 50 tons, all in a state of putrefactive fermentation, and penetrating largely into some of the lower apartments of the dwellings which surround them. These places abound in the lowest lodging-houses, and in habitations full of wretchedness, where, to take a single example of one of the more extreme cases shown to me when visiting them during the day, a room was noticed with scarcely a remnant of furniture, and in which there were two children of two and three years of age absolutely naked, except in so far as they were covered with a little straw to protect them from the cold, and in which they would not have been discovered from the darkness that prevailed had they not been heard to cry.

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* See Local Report on Newcastle.

Piggeries were pointed out to me which added their offence to the other causes that have been enumerated.

Without adverting, however, to more of the most wretched tenements which were visited, it may be sufficient to state that fever is never absent from some of these districts, convalescence from any disease is greatly retarded, and some houses are in such a condition that fever has been noticed to attack successive families who have occupied them.

In one of the communications made to me by Mr. Wilkinson of Newcastle, Sandgate is more especially referred to, which constitutes the principal locality in Newcastle in the position now under consideration. There, many habitations may be seen such as have been mentioned. In respect to it, it is stated by Mr. Newton,—

> "In Sandgate, a part of which is in my district, fever is very prevalent; and, whatever disease a patient is suffering from, fever is liable to supervene, and convalescence becomes almost an impossibility. Fever is never absent from the locality. The state of the drainage, the accumulation of filth in the narrow alleys, the overcrowded state of the tenements, the want of an accessible supply of water and of privies, are quite sufficient to cause this state of things."

In referring to another part of the same district, after noticing the frequent recurrence of fever, he proceeds to state,—

> "One house is worthy of notice. It is not always occupied, but when the tenant enters it, the event most likely to happen is a case or two of fever. I have attended five consecutive cases occurring in one family. The house is extremely damp. Dr. Mason makes the same remark in reference to this place. Fever is frequently in this locality, which, at first sight, you would imagine to be healthy, owing, I think, to want of drainage," &c.

In Sunderland, the practice of appropriating complete rooms as receptacles for refuse prevails to as great, if not to a much greater extent, than in any of the other towns. It still continues to exert its baneful influence, though it has been pointedly referred to on different occasions, particularly by Dr. Haslewood and Mr. Mordey, in their History of the Treatment of Cholera, as it appeared in Sunderland in 1831. They state,—

> "A practice prevails, in many of the inferior streets, of having common middens let into the houses, which are receptacles for the ashes and filth of the street. Trap-doors are affixed to them; at stated times the contents are sold to the country people as manure, and become a source of profit. These nuisances ought to be immediately removed: in some long streets there are as many as ten or twenty of them. In many of these streets the houses are large and well built; with rooms of a much more comfortable description than the ordinary dwellings of the labouring classes possess. These houses, now divided into tenements, were formerly the residences of the wealthiest classes. With this exception, Sunderland is not worse than other towns connected with shipping; yet the duty of scavenger does not seem to be well understood; and these middens, above all, ought not to be suffered to pollute the air, and still more the houses of which they form so

essential a part. The situation of Sunderland, shelving towards the river, would seem to render it a town which might be kept clean without difficulty."

The deficiency of appropriate dust-bins was everywhere a cause of great annoyance among the dwellings of the working classes, and no circumstance appeared to me more fruitful of nuisance and disease than the attempt to accumulate the refuse of such privies and dust-bins as there were, for the purpose of selling it to the neighbouring farmers. For the small remuneration which the tenants thereby receive, a constant scene of filth and offence was maintained throughout the year. The landlords and farmers were led to encourage undue accumulations, and the local authorities were too often prevented from exercising their power in such cases as came under their jurisdiction, from the feeling that they were depriving the poor of a valuable source of income; forgetting the much larger expense of disease and death which too often resulted from such causes. If there was one point more than another on which all parties were universally agreed, it was the absolute necessity of appropriating all ordinary refuse in towns as public property, and enacting regulations accordingly, applicable to all cases, and subject to such modifications as the drainage and sewerage required might render necessary.

In one or two isolated cases, opinions are still maintained as to there being little or no danger from offensive emanations; but these were few and far between, and, in every place it may be stated, that there was a full and increasing conviction among the great majority of those who had given any attention to the subject, that disease, particularly fever, was the necessary, and almost certain consequence, of such accumulations as have been adverted to. So far as I could trace any exceptions to this rule, which led those who brought them forward to make them the subject of discussion, it appeared to me that the individuals who escaped from fever owed their immunity to a high and powerful state of health, induced by constant, but not excessive, bodily exercise in the open air, to a plentiful and generous diet, and sometimes to the nature of the materials which they used in the manufacturing operations in which they were engaged; but, wherever the constitution had been broken down by disease, poverty, dissipation, or the injurious influence of an oppressive atmosphere, there it became too often the prey of noxious exhalations; and the general languor, as well as the appearance of the countenance, unequivocally demonstrated the effect which had been produced.

A circumstance requires to be mentioned here which appears to exert some influence in sustaining such defective arrangements as are now in force for cleansing, sewerage, and drainage, viz., the extent to which it is considered that the ordinary refuse of dwelling-houses may be rendered of inferior value for agricultural purposes, if conveyed to a distance, under circumstances that would prevent its economical application. This opinion was also associated with a desire to preserve the waters in the vicinity as free as possible from any injurious contamination. Though many questions on this point were pressed on my attention, in no place did they appear to have been so much an object of consideration as at Carlisle. There, however, the drainage and sewerage is at present in as defective a condition as in any place almost which I have hitherto seen. It should also be remarked that the town is never free from fever. The publication of the evidence laid before the Commission will necessarily lead to many new and important considerations on this point.

Stagnant ditches may be observed in the vicinity of some of the best and newest houses. Part of the ground in the lowest districts is apt to be flooded after heavy rains; and long open sewers traverse the public walks and outskirts.

In the Report of the Local Committee it is stated that—

> "Drains or sewers generally exist below the level 'of the cellarage,' but they are very imperfectly constructed. They were originally formed without any artificial bottom, and varying in size from four inches square to six by nine. These have been partially improved from time to time by the proprietors opposite their own property, but without any systematic plan for their mutual correspondence; yet into these the contents of several water-closets are discharged. As may be supposed from the above accounts, the house-drains are very liable to become choked, and in some instances have been so offensive that all communication with the main-drain has been filled up, and the cellar drained into a shallow well, which is emptied when needed."

If we turn from Carlisle, where there is so little drainage and sewerage, to Newcastle, we shall find there (exclusive of those without the jurisdiction of the authorities) thirty-three streets within the borough which pay rates, but in which there is neither drainage nor sewerage. Sandgate is one of these, on which observations have already been offered as to the prevalence of fever, and the difficulties of convalescence from any serious disease. If we cross over to Gateshead, we shall find Pipewell-gate, including Bankwell-stairs (and the open sewer figured in the plates), which rival Sandgate in every respect. On descending by the river to North Shields, the principal street next the river presents a long narrow street similar to Sandgate (in Newcastle), and the sides of the bank pour their contents freely into it. Crossing the river, a similar scene is again presented in the eastern part of South Shields, containing the habitations of the poorest of the population. All the similar streets now mentioned, were they alone referred to, afford abundant evidence of the causes of that amount of disease which led the towns in which they occur to be selected as objects of particular attention.

Passing over to Sunderland, including Monk Wearmouth and Bishop Wearmouth, the system of cleansing, drainage, and sewerage is on the whole little if at all better in efficiency than that observed in other places, though the magnitude of the area on which it is spread, the natural advantages which it has, particularly its vicinity to the sea, and the extent to which it is intersected by the deep valley through which the river winds, and the many avenues that open around it, all conspire to place it on a more favourable footing than many other places in the northern district. These considerations should have led to the anticipation that the mortality would have been less marked in Sunderland than it actually is, taking into account what has been represented as to the number of sailors who are said not to have been included in the returns of the population, though the deaths in this class are generally added to the Mortality Tables. A reference to the Local Report will show that Sunderland labours under disadvantages which counteract all those favourable circumstances, and adverting here solely to the worst parts of the town, the Local Committee affirms emphatically, that "much filth, great poverty, and a total absence of proper drainage and ventilation are to be observed."

In Durham, the sewerage, drainage, and cleansing is much on the same footing. The want of effective regulations, the very imperfect manner in which public drainage is effected, the want of compulsory powers to enforce private drainage, and the discharge of liquid refuse into the street channels, are all points which are strongly urged in the Local Report, and the importance of which is attested by the condition of numerous habitations in lanes and alleys, and even in those in the vicinity of the most public streets.

It may be confidently affirmed, accordingly, both from what I have witnessed with respect to the state of cleansing, drainage, and sewerage in every town visited in the northern district, as well as from the additional evidence afforded in the Local Reports, that they all suffer much from the want of sanatory regulations; and that the inhabitants themselves are now fully satisfied that it will be impossible to place the state of the public health on a satisfactory footing unless much more extensive measures are introduced than have hitherto appeared in any general or local Act.

The details in the Local Reports afford many examples of increased expenditure in the construction of drains and sewers that may now be avoided, of different forms of sewers which have failed, and of the cost of those in use; the attentive examination of these, and of the reduced size which many of them admit, particularly the house drains, on the right management of which so much depends, will afford important considerations in estimating the expense of any sanatory measures for drainage and sewerage.

SUPPLY OF WATER.

This important subject, bearing so intimately on the health and comfort of every population, demands the aid of legislative assistance in no place, perhaps, more prominently than in the northern district. Carlisle and Durham may be said to have little or no systematic arrangements for the supply of water, depending entirely on public or private wells. There are no water-works in Durham, nor any system of water-pipes, excepting those conveying water from a spring to a public fountain, and consequently water is not laid on into a single house in this town. The arrangements in Carlisle are equally defective, and great complaints are made in both places of the defective supply and of the cost of the water. At Carlisle a tank at the gaol, supplied by the tread-mill, forms the sole reservoir where any large collection of water can be obtained; but there is only a very limited extent of pipes connected with it, so that it has been of little use for general purposes, except being occasionally employed for cleansing the streets, and also in cases of fires. Mr. Stephenson has lately given in a Report, both on the supply of water to Carlisle and on the drainage of this town, and the consideration of both these questions has been postponed, as he has recommended, till the recommendations of the Commission shall have been brought forward.

In Newcastle a supply of very indifferent quality, costly to the poor, and not sufficient in quantity for the wants of the population, had rendered this subject one of much local discussion, and various projects for increasing the supply, for its more extensive distribution, and for procuring it from more distant localities, where it could be procured of a better quality, formed subjects of daily conversation. In all the other towns visited in the northern district, there was abundant evidence of the want of a proper supply for the health and comfort of the labouring classes, though the more wealthy inhabitants enjoyed a better supply, and paid much less for what they consumed. This deficiency of supply was manifested not only in the arrangements for domestic purposes in the habitations of the poor, but also in the ordinary condition of the house-drains, which were not at all numerous, and in the stagnation even of the open water-courses, when an abundant rain did not remedy the consequences of this neglect. It is only just to observe, however, that companies which were formed principally at former periods with a view to a profitable investment, should not be viewed in the same light and under the same circumstances as any new company would be, acting under the information that has been recently gained in respect to the condition of the working classes, the more extended demands for water, as well as the more improved means by which they can be economically satisfied.

Since I visited Newcastle-on-Tyne, Mr. Sopwith has informed me that a new project for supplying this town with water has attracted considerable attention. It appears, according to the statement made to me, that an abundant supply can be obtained from Whittle Dean, a distance of about 11 miles, and that, though a considerable expense would be required in providing the necessary pipes, water from this source would have the great advantage of being of a better quality than that at present supplied, while it would also be obtained from an elevation which would command sufficient pressure to raise it above the highest houses, and dispense altogether with the necessity of pumping, its altitude being about 360 feet above the level of the Tyne.

The practicability of this measure will no doubt engage special attention in any revision of the question of the supply of water to this town.

It has also the advantage of being free, from its geological position, from those disturbing causes that are prone to affect all sources of water in the colliery districts near to Newcastle, as the springs rise in the millstone grit formation which underlies the coal measure, though in point of actual altitude it is considerably above them.

At Gateshead, the supply of water is obtained principally from the Newcastle Company, and from wells: only 110 houses have the water laid on. Everywhere there is only a very imperfect supply of water compared with what is essential for health and comfort.

In North Shields, the quality of the water is reported to be good, and the supply plentiful; but in respect to the latter, it must always be understood that such replies are offered without any standard being kept in view, beyond that which prevailed previous to its more general introduction in dwellings, and its application to drainage and sewerage had become an object of minute investigation.

In South Shields the supply of water is obtained principally from three springs, and is distributed by pipes and water-carts. There are 24 stand-pipes, at which the poor are charged at the rate of a farthing for six and a half gallons. There are 8911 houses, and of these 179 have the water laid on, while 977 are supplied by contract from the stand pipes, at 1½*d.* and 2*d.* per week. In respect to the habitations of the extremely poor, the same remarks apply as in other towns, though in price and other arrangements for its distribution, the poor are more favourably situated in South Shields than in some of the other towns visited.

In Sunderland, as in other places, the supply of water and mode of distribution are far short of that which is essential for health and comfort. The same general deficiency in the supply afforded to the humblest classes that forms so important a subject of consideration in the metropolis, is observed equally in this and all the towns in the northern district, though their deficiencies are not probably greater than are observed in parallel circumstances elsewhere.

Where stand-pipes are common, the distance and labour of carriage, and the time lost in waiting, add greatly to the price paid for water.

In Sunderland, places were pointed out to me in the course of my visits where wells, which had been in use by the public, were removed and not replaced again; this affords another argument in favour of a systematic survey, such as has been already adverted to.

One of the most important considerations connected with the supply of water in the mining districts, is the extent to which such supplies are liable to be effected by mining operations; various examples of this were mentioned to me, among which I may refer more particularly to that which occurred not long ago at Sunderland. In the Local Reports it will be seen that when the Monk Wearmouth coal-pit was sunk, the inhabitants suffered great inconvenience at that time, in consequence of all wells having been drained on the north bank of the river (except at Southwich), when they were under the necessity of obtaining supplies from the neighbouring village. This occurred in the year 1828, and the local committee, when they informed me of this circumstance, expressed their apprehensions that it might occur again.

The following table presents a general view of the state of the principal towns in the northern district, in respect to the supply of water:—

Name of Town.	Name of Company in Towns supplied by Pipes.	Source of Water.	Quality of Water.	Stand-pipes or Pants.	Price per Skeel.	Number of Houses.	Number of Houses Supplied.	Price for Ordinary Supply.
NEWCASTLE	Newcastle Joint-Stock Water Company.	River Tyne . . . . . Carr's Hill . . . . . Cox's Lodge . . . . Town Moor . . . . . Private wells . . . . Rain water	River soft, —— brackish, —— miry, Springs hard, Wells hard, Rainy, loaded with soot.	20 public pants provided by the Corporation; 32 for the sale of Water provided by the Company.	¼*d.* per skeel*	15,000	1350	18*s.* to 30*s.* exclusive of horses, carriages, and closets.
GATESHEAD	Newcastle Joint Stock Water Company.	Newcastle Water Company, wells in.	Same as in Newcastle.	Six pants	¼*d.* per skeel	3,495	110	10*s.* to 30*s.*, according to the rental.
NORTH SHIELDS . .	Proprietors of North Shields Water Works.	3 springs in Clinton; 1 in Preston; 1 in Whitley, through limestone.	Good for domestic uses, and no complaints.	Several pants and water-carts.	¼*d.* per skeel	4,000	223	18*s.* to 36*s.*; 1 house, 50*s.*; supply unlimited.
SOUTH SHIELDS . . .	South Shields Water Works Company, and private individuals.	Cadwell spring, through limestone; Dean-Well and Pigeon-Well, through free-stone.	No complaint	24 pants and water-carts.	¼*d.* from pant ½*d.* from cart	3,811	179 977 houses supplied stand-pipe at 1½*d.* to 2*d.* per week.	10*s.* to 30*s.* per year; supply unlimited. Poor persons, 1½*d.* to 2*d.* per week.
SUNDERLAND	Sunderland Water Company.	Below limestone 27 fathoms deep. Wells.	Pure and good . . .	29 pants	¼*d.* and ½*d.* per skeel.	6,086	670	10*s.* to 30*s.* W. C. 6*s.* Bath, 4*s.* to 10*s.* Horses, 6*s.* to 12*s.* Carriages, 8*s.* to 10*s.*
MONK WEARMOUTH .	No supply by pipes.	Pott's pump, Lee's Well, Newton's Well.	Good for domestic purposes.	. . .	¼ of 1 penny per skeel.	. .	No water laid on, but conveyed in skeels.	
DURHAM	No supply by pipes.	A spring and various wells, also the River Wear.	Well tasted and wholesome.	. . .	. .	. .	No water laid on.	
CARLISLE	No supply by pipes.	Rivers, rain, and pumps.	Soft from rivers; from pumps earthy, and not sufficiently pure.	. . .	. .	. .	No water laid on.	

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* A skeel contains, on the average, about 5 gallons.

An examination of the Local Reports will show that these have not generally engaged attention in the northern district, in so far as the interests of the poorer part of the population are concerned. Mr. Greenhow informed me that Dr. Headlam endeavoured to realize this important object some time ago, when the present Newcastle baths were erected. Considerable care appears to have been bestowed in providing baths in some of the towns, and their cost does not appear to exceed that which usually prevails. Such as they are, however, they are altogether beyond the ordinary resources of the poorer classes. In this mining district, the extreme economy of coals, and the numerous engines from which waste steam may be procured, give it many facilities for the erection of baths, washing-houses, and drying-houses which few other places can present; and a reference to the Local Report on South Shields will show that there, a large supply of hot salt water, amounting to about 130,000 gallons daily, at a minimum temperature of 130°, is at present allowed to run to waste, while there are many opportunities by which hot fresh water might be obtained advantageously at various coal-pits as well as at manufactories in towns, where it is at present turned to no profitable account.

No wash-houses on any systematic or extensive plan, such as those at Liverpool, came under my observation. In South Shields there are two public wash-houses, which appear to have been very useful, but they are objectionable on account of their distance from the town, and are of the rudest construction, being little more than mere sheds, having a chimney at one end and no fire-grate. The washer-women build their own grates with loose bricks, and the fire-place extends over nearly one-third of the floor (See Local Report). The charge to each woman is 4*d.* per day, besides providing her own fuel.

No proper or effective drying-house was noticed in any of the towns under consideration. The great extent to which smoke is often deposited in some of the towns, where it prevails most extensively, renders it very desirable that drying-houses should be provided where clothes can be rapidly dried, or supplied with a current of warm air previously filtered from suspended soot (when, from the inclination of the wind, it is largely deposited in the vicinity), by passing it through any porous texture.

The adjustment and management of apartments for drying linen or other fabrics are seldom arranged so as to secure their effective and economical action. In general the moist air around the different textures is not removed with sufficient rapidity. It stagnates around them and restrains further evaporation. A copious ingress of warm air below, and a valve to regulate its discharge above, when a higher temperature may be requisite in expelling the last portions of moisture, appear to be the great desiderata, where currents urged by machinery are not so conveniently applied. Mr. Liddell, of Carliol-street, Newcastle, who has paid much attention to the means of improving the condition of the labouring classes, has for a long period endeavoured to direct attention to the great importance of supplying the miners with efficient means of drying their clothes at the mouth of the pit; the waste steam from the engines might be easily applied to such a purpose at a very trifling expense. As yet, however, little or no progress has been made in this improvement, which is equally applicable to wash-houses, mines, and all manufacturing establishments, where it would contribute very materially to the improvement of health.

DWELLING-HOUSES.

Next to the bad effects inseparably associated with deficient drainage and supplies of water, none stand forward so prominently in producing discomfort and disease as the absence of those conveniences which are equally essential to health and decency, but which are so deplorably deficient in the habitations of the poor in every town which has been visited; though I cannot say that in the towns of the northern district the habitations of the poor are worse in this particular than they are in London and most other places. The natural aversion to the due investigation of such subjects has led to the production of evils of such magnitude, and of so much suffering in the humblest habitations, that public attention has at last been sufficiently directed to its importance, and accordingly the means of improvement universally formed an anxious subject of inquiry. While many of the more modern improvements in connection with house-drainage and sewerage formed the desiderata that attracted most attention in each of the different towns, numerous individuals entertained strong objections to the universal application of such remedies, on the ground of the extent to which they might thereby be deprived of manures, which at present were rendered available for agricultural purposes, while they were not sufficiently satisfied as to their being effectually replaced by any general measure which might withdraw them from the sources where they are at present accumulated. It was considered that the value of land would be greatly enhanced in some districts by such alterations, and that it might fall proportionally in other places which could not, from local circumstances, be capable of being benefited to the same extent. Many cases presented themselves where attempts were made to increase the value of manure, and diminish the amount of nuisance usually arising from a common privy, by the admixture of materials absorbent of moisture, which arrest temporary decomposition, and retain a considerable portion of such ammonia as might be developed. These have by no means been placed in that condition, however, which, with the assistance of a very slight knowledge of chemistry, they might be made to assume. But whatever local exceptions may occur in individual places to the introduction of systematic means of drainage or sewerage, in conjunction with the best system of removing refuse, we must recur to the primary consideration that separate conveniences in each house or habitation, appear to be essential in every attempt that may be made to improve the general condition of the dwellings of the labouring classes. The united experience of all professional persons appears to agree as to what indeed must be self-evident from a consideration of the subject, that the cases of distress and suffering from this cause alone are innumerable, and engender an amount of disease scarcely to be credited, which not unfrequently becomes ultimately a cause of death, or at all events, of permanent bad health.

Another circumstance which contributes much to reduce the comfort of the humblest habitations is the small number of apartments which they so often present. It has been again and again represented to me that if, for a family consisting of several individuals, three or four separate apartments could be provided, besides the ordinary living-room or kitchen, it would be a source of immense advantage in such dwellings, though the size of such cabins should not exceed that of the sleeping berths ordinarily found in the living-rooms. They would permit that separation of the sexes which, under existing circumstances, cannot be attained. Such small apartments are in themselves anything but desirable; they are, however, preferable to the present arrangement in numerous dwellings having only one apartment for a whole family. The expense of these, if designed in unison with the original structure, would be comparatively trifling. Adequate ventilation might be secured without difficulty, by providing two appropriate channels to each apartment, one for the ingress, and the other for the egress of air.

No cause of insufficient accommodation was more frequently observed than the occupation by the humbler classes of single rooms in large houses, which had been previously inhabited by a very different class of society. The blocking up of windows too often appears to have formed the first step in the transition. Among the many communications made to me on this subject, I may quote more particularly the following extract from Mr. George Richardson, of Newcastle. He states—

"But no circumstance has contributed more to injure the habitations of the poor, and to diminish their healthiness, than the tax upon windows, the manner of its assessment, and the high duty upon window glass. During the long war, each window above ten was subject to an additional duty of 15*s*. The graduated scale was adopted on the presumption that the number of windows in a dwelling-house might be regarded as a criterion of the occupier to sustain taxation. Hence cottages of some description were exempt. Houses of six windows or under had only to bear a tax of 8*s*. on the whole house, or equal to 1*s*. 4*d*. per window; whilst a house of ten windows was charged 2*l*. 10*s*, or 5*s*. per window; and for every window above ten, 15*s*. was added.

"In cases where one family only occupied a house, the criterion of ability might perhaps be a pretty sound one; but it wholly fails in the case of large houses let in tenements to the poor.

"In the year 1805-6, this subject was pressed upon the attention of the writer of these remarks, in consequence of his being appointed collector of the assessed taxes. He had to demand from 3*l*. 5*s*. up to 25*l*. 15*s*. from the proprietors of houses let in tenements, with many of the intermediate gradations, as to number of windows and amount of assessment, being in the former case, on a house of 11 windows, about 5*s*. 10*d*. per window; and in the latter, on a large house of 43 windows, being nearly 12*s*. per window; and most of these rooms were occupied by very poor persons. In this latter case, the tax could not be collected without obvious oppression, and was allowed in the tack note.

"This heavy taxation naturally induced proprietors of such property to close up every window not absolutely necessary for light. Many of the staircases were so darkened that it became necessary to grope the way up them, at noon-day, as at night. The effect of this process upon ventilation was deplorable, and continues to operate to this day, for although the tax upon windows is considerably reduced, yet it falls heavily upon such houses."

Mr. Richardson further refers to the circumstance that the tax is still upwards of 9*s*. upon every window above ten, which necessarily operates with severity, particularly where many of the rooms do not bring a higher rent than 50*s.* or 60*s.* per annum.

The tenements into which large houses are divided, when broken up into many habitations, are necessarily deficient in many such accommodations as sculleries and dust-bins, as well as closets, which contribute so materially to the improvement of health and comfort.

Where the working classes live in houses built especially for their accommodation, the result is exceedingly various, whether we look to their position in towns or to the pit-rows, or other similar buildings which may have been erected at a distance. In Newcastle I might refer more particularly to a series of houses built by Mr. Sopwith, as an example of the care which is bestowed upon them, where the proprietor studies the wants of the occupants, and adapts his buildings accordingly, so far as local circumstances will permit. Others might be quoted where the very opposite results are presented; so much depending upon the interest and anxiety that are taken in the construction of such dwellings. Their condition, indeed, occasionally rivals that of the most inferior dwellings observed in the most crowded and oldest part of different towns. Both classes of habitations equally demand public supervision. A considerable number of examples were also pointed out to me, of tenements altogether uninhabited, and even in a dangerous condition, while no one appeared to interfere in taking those precautions that were necessary for the protection of the public from accident. I may refer more particularly to the Local Reports for proof of the importance of more extensive powers being given to the public authorities for the regulation of buildings than are contained in any local Act, and for proof that some of the existing regulations are at present altogether inoperative.

Again, in respect to heat, no habitations can be expected to be in a better position than those in the centre of a great coal-mining district. The principal peculiarity that they present is the large and substantial fire-place, and the quantity of fuel which extreme cheapness permits to be consumed. Nevertheless this subject demands, even in this district, a much more minute and careful attention than has hitherto been bestowed on it. In proportion to the abundance of fuel, so also are extreme draughts and currents multiplied, which prove exceedingly offensive, and lead to endless attempts to reduce their intensity; this, as in other places, is rarely effected by any systematic or consistent plan. The large and excessive area of the chimney, heated powerfully by the combustion of the fuel, determines a free and rapid circulation of air when the supply from without is not cut off or reduced by air-tight doors or windows. Until the area of the chimney-flue shall be reduced and controlled by the power of a valve, and a legitimate channel for the ingress of air to supply the fire be introduced as regularly in the construction of houses as the flue for the discharge of products of combustion, this department can never be placed on that satisfactory footing which health and comfort equally require. Above all, where large currents of air are freely introduced, they should be made to impinge on some warming surface, whether that be a separate apparatus or part of the open fire or stove in use, before circulating through the apartment. Were the dwellings of the poor constructed systematically in towns, and arrangements made for warming, ventilating, and other purposes at the same period, much might be done with great economy to give them some of these advantages which have been realized hitherto only in public buildings and manufactories. And were the stairs of old tenements flooded with warm air, heated by an Arnott's stove or some other equivalent arrangement, it would act beneficially on every separate room with which they communicate.

It is impossible, however, to view the question of heat, whether applied to public buildings, the houses of the rich, or the dwellings of the poor, without taking into consideration at the same time that of ventilation, as all communication of heat necessarily determines movements of the atmosphere in its vicinity. Illustrations are accordingly given in the plates, which explain the more leading varieties under which this question is generally presented in individual habitations.

It is scarcely necessary to remark, that the habitations of the poor are almost universally deficient in all those conveniences which an increased supply of water and systematic house-drainage and sewerage would permit, and be the means of introducing to a much greater extent than formerly.

LODGING-HOUSES.

The lodging-houses for the extreme poor present the most deplorable exhibitions of the want of sanatory regulations that are perhaps to be observed in this country. Crowded in the extreme, dirty, ill-managed, ill-ventilated, occupied promiscuously by both sexes, and frequented by vagrants, trampers, and all those who have no fixed habitation or employment, it is not surprising that they are too often the nurseries of disease of a malignant character, and that they are as much a moral pestilence in their present form as they are injurious to the health of their inmates and to the public. To those who have not inspected these lodging-houses it will be difficult to convey any adequate idea of their condition; but when it is recollected that numbers, unconscious of their nature, fall victims to fevers and other diseases which they contract there, it will not be deemed singular that they should be universally regarded as demanding a more strict and careful supervision than has hitherto been bestowed upon them. The testimony of medical men, and other officers, has shown that such diseases are often propagated in this manner to a great extent, and that many individuals thus become a burden to parishes who might otherwise have escaped with impunity. Among many of those visited in the northern district, I may refer to two apartments in Carlisle, which were more especially brought before my notice by the Committee in that place, and in which there was neither window nor fire-place; seven cases of fever had occurred there within two years, though I have no reason to believe that this number expresses the amount of all those who were attacked with fever in the house. In Newcastle, on entering one of these lodging-houses, crowded with beds, the occupants were endeavouring to remove a woman who had been attacked with fever, and who was at the moment very much excited, and almost delirious, remonstrating bitterly and with extreme earnestness against leaving the place without her clothes being returned to her, which, as I understood, had been pawned for the payment of her lodging. In a third case at Gateshead, I noticed five beds in one room, in each of which there were from one to three persons unwell; and, from examining them individually, I had no reason to doubt that they were all labouring under serious illness, though I could not satisfy myself, during the single visit I had the opportunity of making, that they were all cases of fever. But it is unnecessary for me to enter into further details on this point, as the evidence already given before the Commission in London, as well as that which will be observed in the Local Reports, explains the extreme numbers that congregate in such apartments, and many other circumstances that cannot fail to lead to a careful consideration of the proper remedies for so great evils. It should be understood, however, that the accumulated evils arising from poverty, dissipation, and disease, attain such a height, and so perfectly callous do the inmates become to every sense of propriety, that cases occur, more especially in the metropolis, where women are confined while the other lodgers, amounting often to 10 or 20 (in one instance a greater number was mentioned), never think of retiring. Nor ought it to be supposed that such lodging-houses exist only in the metropolis or in manufacturing towns: in the common lodging-houses in Durham, the local Committee state that, "for a trifling sum, vagrants and itinerants, whether healthy or diseased, are furnished with lodgings, and persons of both sexes are indiscriminately mingled together."

VENTILATION.

The state of ventilation in any apartment depends essentially on three conditions,—the quality of the external air; the quantity that can be made to flow throughout it in a given time, including its mode of distribution, and the regulation of which it is susceptible, whether we regard the temperature communicated to it or the force with which it impinges on the system; and its freedom from any noxious ingredient that may be developed by lamps, candles, fire-places, or any other special cause. Where sanatory measures sustain a pure external atmosphere by effective drainage, cleansing, and prevention of nuisances, one-half of the remedy may be said to be already secured, and without such measures no system of ventilation can be successful. Examples are not wanting where it may be a fair subject of discussion, whether it is not better to suffer a certain amount of deterioration of the atmosphere from within, when this does not proceed to extremities, than to permit a free and overflowing atmosphere from without where it is overloaded with emanations from drains or extreme accumulations of decomposing refuse known to produce disease. Such cases, however, are to be considered as rare exceptions,—a stagnant atmosphere without receiving in general only additional contamination from within, which renders it still more deleterious and oppressive by the impurities communicated to it in all inhabited apartments. It is thought right, however, to advert to the extreme importance of beginning, in all cases where it is practicable, with a pure atmosphere, as cases have occurred where disease has been propagated by ventilating apertures, selected without reference to the nature of the air which necessarily entered by them, particularly when taken from the surface of the ground, or from sites not regularly cleaned or subject to inspection.

In the northern district, as in other places, little or no ventilation is in general observed in any of the dwellings of the different classes of society beyond those usually accessible by the medium of doors; windows, and fire-places. In such examples of any attempt at systematic ventilation as came under observation, the leading defect was, that though an escape was provided for vitiated air, systematic arrangements were rarely adopted for securing the admission of fresh air.

The consequence of this was, that the discharge could not operate, except with such casual force as the irregular entrance of air permitted. It did not appear to be practically understood that, where there is no entrance there can be no exit, except through the conflicting process of a double current (an ascending and descending movement) through the aperture that ought to act as a discharge alone. Nor did the operation of the fire and fire-flue, in relation to ventilation, appear to have been more specifically investigated than in most other places. Again, where ventilation had attracted considerable attention (and in this mining district certainly many individuals were well aware of the important relation which it bears to health), the means of regulating the quantity, or diminishing the offensive impression produced by local currents, had not been brought into extensive operation. The constant complaints were—" we have too much air;" or " we have too little;" " the draught is too strong;" or, " we are oppressed with heat;" " our feet are cold, but there is a sense of fulness and of headache." These evidently indicate the necessity of controlling and regulating the ingress to a much greater extent than can be effected by doors or windows alone; of establishing a proper relation between the ingress and the egress, and of proportioning the ingress to the amount of supply, required both for any fire-place that may be in action and for such egress as may be provided.

It fortunately happens that the means requisite for these essential positions are much more simple for individual apartments (which are not densely crowded like public buildings) than for larger structures, for if an aperture for the admission of air of sufficient magnitude be always left open, then it will only be necessary to diminish the extent of opening left for the discharge by a superior aperture, or the opening in the fire-flue, according to the relative rapidity with which it may be required that the ordinary ventilation, or the heating power of the chimney, shall act.

In the preceding observations, no reference has been made to ventilation by forced currents, induced by any means, except those accessible in almost every apartment, as these are not considered absolutely essential for ordinary purposes, though very desirable when provision is made for them by arrangements incorporated with the original structure. I cannot omit to notice, however, that, where gas is introduced, or any brilliant illumination is employed, there the saturation of the air with moisture, and the extent to which it is vitiated by carbonic acid, demands in general a special provision, in order to secure satisfactory ventilation. Few cases presented themselves where gas is so largely used as in the metropolis, and none such as are so abundant there, more especially in shops and offices, in which the ordinary gas-lamps are lighted during the day (when required for heat and not for light), and the external air excluded as much as possible, that the vitiated air with all its warmth and oppressive deleterious products may be retained, no other source of heat being provided.

Were it more generally known, that the movement of an ascending current from lamps is always accompanied in non-ventilated apartments by a proportionate descent of vitiated air which may have previously supported combustion, and that this descent, though limited at first, may ultimately reach the floor, greater anxiety would be manifested in removing such products by a superior aperture. Nor should it be forgotten, that this ascending power which gas-lights, candles, and all other warm objects usually have, is in reality a ventilating power, which may, almost universally, with proper management, be made to correct the evil they otherwise induce, and even to assist or command general ventilation. Further, independent of the occasional presence of sulphureous and other offensive products from gas, the quantity of air consumed by excessive illumination produces an amount of carbonic acid and moisture far exceeding that commonly evolved by lamps and candles, and this necessarily demands a proportionate increase of ventilation. In some cases gas-stoves may be observed, which in very small apartments, not provided with fire-flues, often prove more manageable than any other stoves or fire-places, notwithstanding the expense of fuel; but these also, unless the products of combustion are removed by an iron or other tube as systematically as those that proceed from a common coal fire, are still more injurious than lamps, from the lower position in which they are usually placed.

Ventilation is universally observed to be most defective where great destitution prevails, as a low diet renders the system less capable of bearing that amount of air which would otherwise be agreeable. Protection from cold is the first and great desideratum which the constitution demands in any apartment, and the less the supply of the air, where the chemistry of the system is not in high condition and amply supplied with materials for producing internal warmth by those processes that elaborate the products of digestion and apply them in every part of the living system, the less is the extent to which its influence is felt. Hence, in the habitations of the poor, economy in the management and application of fuel, and diffusion to an extent, such as will render the air gentle in its impulse upon the person, become more and more important in proportion as the circumstances of the inmates are reduced. Similar remarks apply in all cases when the constitution has been enfeebled by disease, want of exercise, or a vitiated and too warm atmosphere, even among those whose means command every luxury that can be purchased for their gratification.

Again, the extreme difference in the demands of the same constitution at different periods (passing over the diversity of different temperaments) scarcely satisfied with one or two hundred times that amount of air when it is warm and loaded with moisture, which is abundantly sufficient when comparatively dry, and at a very low temperature, shows the necessity of providing in each individual apartment such openings as may admit at all times of a gentle and regulated movement, though cases constantly occur when, without a wide opened window, or a special ventilating power, an adequate supply of air cannot be obtained.

The application of any measures for forced ventilation in ordinary apartments beyond what can be commanded by their natural warmth, and the influence of the fire, or of the fire-flue in warming the wall, does not appear to have been made a particular object of attention. Were the kitchen fire-flue—or any separate flue immediately adjoining it—to be arranged so as to receive a communication from each individual apartment, being made of a magnitude corresponding with their number, great facilities for ventilation could be introduced in all new structures for promoting those natural movements by which ventilation is most satisfactorily sustained.

The ventilation of workshops and manufactories claims as much attention, and is fully as important to those who are engaged in them, as the ventilation of their dwellings. In the latter they may spend from a third to a half of their life in a vitiated atmosphere, and at all events that period of repose which is often oppressive and unrefreshing from this cause. But in manufactories, more especially where the occupations are sedentary, where the vicissitudes of temperature are extreme, where siliceous, metallic, or other particles are received into the lungs, and induce disease by mechanical irritation, or when acid and corrosive or other deleterious emanations produce still more rapidly dangerous consequences, the subject of ventilation demands a more earnest attention, and is important to the manufacturer who is deprived by early death of skilled and valuable workmen, independent of the severity with which such causes prey upon them and their families.

In all such cases the great point which the manufacturer should endeavour to attain, when practicable, is the direct removal of noxious emanations from the very source at which they are developed. General ventilation must be superadded to give complete relief, but if noxious emanations be once permitted to escape into the atmosphere of the apartment or workshop, the entire change of atmosphere is essential to restore freshness to the air; whereas if every noxious product be treated as much as possible on the same principle as smoke, by providing arrangements for the direct exclusion of the products of combustion, a much less amount of ventilation is sufficient, and at the same time the ventilation becomes much more effectual.

Excepting sedentary occupations, where no peculiar noxious product is to be guarded against, the extreme variety of circumstances peculiar to each occupation in which noxious ingredients are communicated to the air in confined apartments, renders any general plan of operations impracticable beyond what has been indicated, without introducing an amount of interference that might be too prejudicial to the interests of the manufacturer to be generally supported.

The amount of suffering, however, and of early death under many circumstances, is so great, that any systematic means of fixing public attention on this subject, to such an extent as would explain the cause of death in factories where it is excessive, and the economy of sanatory measures, would be attended with very beneficial results, equally apparent both to the proprietor and the workman. To the former alone can we look for the general introduction of sanatory measures in their respective establishments; but more intelligence among the workmen is essential to enable them to appreciate and take full advantage of such opportunities as they may have.

As to the improvement of ventilation in crowded workshops occupied by tailors, milliners, shoemakers, and all persons engaged in sedentary occupations, where few or no deleterious products are evolved beyond those that arise from respiration and combustion, the question would be more justly stated were it described as a question of warming as well as one of ventilation, as it is rarely observed that there is any objection to the discharge of vitiated air when that which enters is adapted to the state of the system. Undoubtedly, a regular egress for the escape of vitiated air is seldom provided; but this can never be placed on a right footing, however much it may relieve distress, till the ingress of air, and the warmth it may be necessary to communicate, shall have been satisfactorily adjusted.

In no case do the evil effects of the imperfect distribution of air manifest themselves in a more palpable manner than where rooms are crowded with individuals engaged in sedentary occupations. An under-current passing along the surface of the floor to the fire-place in winter may occasion, on the whole, a considerable change of air, but its local movement deprives it of almost all its value. The fire may receive pure air, but little or none moves upwards to supply the organs of respiration.

The evils from defective ventilation are then of great magnitude, and the continuity of their operation gives them a power and influence over the system which cannot be too minutely investigated. Few pause to consider the necessary consequences of 20 respirations per minute, 1200 per hour, or 28,800 in a single day and night, where not only a noxious atmosphere is inhaled, and brought directly in contact with the blood, but where also the state of the air diminishes the amount of discharge of those noxious products which the system discharges more and more largely, in proportion to the purity of atmosphere inspired.

Bad ventilation, also, is as injurious to the mind as to the body; and in its more aggravated forms not only induces headache and apoplexy, but, conjoined with other circumstances, is prone to favour that depression which leads at times to low spirits, or even to suicide.

If the progress of air be examined in a room of ancient date, where neither the doors nor windows are air-tight, an ingress of fresh air is almost invariably observed below, and an equivalent discharge of vitiated air above; the fire-place being in this case supposed to be inoperative and closed by an air-tight board. Stagnation is thus prevented, and a continuous, though subdued ventilation, maintained through the apartment, to an extent dependent on the magnitude of the crevices in the doors and windows, and the condition of the internal and external atmosphere.

Again, if the fire be in action in the same apartment, the air in general enters by all crevices to supply the draught it creates, so that in this manner also the freshness of the air is maintained. Farther, the great altitude of the open fire-place in ancient chimney-breasts sustains a very powerful circulation at a higher level than is commanded by low cottage-grates in modern rooms, when the feet may be bathed continuously in cold air, while the head is placed comparatively in a warm stagnant atmosphere, unless crevices in doors and windows permit a considerable change.

It is a matter of much regret that in many houses the supply of air is so perfectly inadequate, both for individual rooms and for passages, that they act continually upon each other, the powerful fire in one room overcoming the weaker draught in the other, and communicating through the passage, which is accordingly more or less filled with smoke, that is—carbonic acid gas, mingled with various visible impurities, particularly charcoal, oily, or other substances.

Vitiated air from lamps and candles, as well as from respiration, tends to ascend, though, as projected from the nostrils and the mouth, it moves, at first, more or less downwards, or in a horizontal direction. In experiments made on this subject, the temperature of air from different individuals placed in a box lined with cotton and open above and below, was found to be generally four degrees higher above the head than below the feet, (the box was suspended in the air), and, at natural temperatures, a current constantly ascended on every side from the person. Thus then it is obvious, that, if the natural movements of vitiated air in ordinary apartments be facilitated by one opening at the lower part, and another above, every room will ventilate itself sufficiently to prevent the more extreme effects that are so often observed at present.

If the lower opening be diffused by extending it along the skirting, the current becomes more mild and equal and less liable to strike upon the person, so as to produce an offensive draught.

If the upper aperture be led into a chimney flue, or into an independent flue warmed by its near position to a hot chimney, its action is more powerful and more uniform than a mere aperture in the wall near the ceiling, and not so subject to modification in windy weather. If it communicate with a powerful chimney-flue, it works still better, except when the fire declines, or the supply of fresh air is interrupted, a dangerous recoil taking place, and the upper aperture discharging smoke into the apartment: this defect may be obviated to a great extent, though not entirely, by the use of valves, unless they be regulated and adapted from time to time according to the varying circumstances of the case.

Two apertures, then, at different levels are the great essentials in each apartment, and so ample a supply to all stairs and passages, that they shall not borrow or draw down air from individual rooms, but give freely to all that do not draw their supply from an external source. The most serious evils from offensive draughts and currents may be greatly diminished by proper diffusion of the air, as well as by the previous communication of warmth to it. Diseases from exposure to draughts appear principally to arise when the constitution has been heated excessively, in consequence of a defective supply of air; but, were a small aperture left continually open, the constitution could never attain that extreme susceptibility of cold, and aversion to the slightest breath of air which so often accompanies too limited a supply, and that reduction of the insensible cutaneous and pulmonary exhalations by an atmosphere loaded with moisture which leaves the surface of the lungs and skin unduly excited and turgid with a load of material that would have been dissipated by exhalation and evaporation with a better supply of air.

When a fire-place is in action, it necessarily complicates the ventilation. But all cases of this kind resolve themselves into the following classes:

The first comprehends those in which the fire-flue alone becomes the discharge of vitiated air. This cannot be considered the best, as, under ordinary circumstances, the fresh air travels along the floor, and little rises to the head, where it is most largely required.

In the second class, the evil effects of the vitiated air which is prone to accumulate above the chimney-breast, are diminished by its being raised to a higher level than is now common, or by admitting the external air from an aperture above, near the ceiling, so as to sweep across the apartment in its descent to the fire-place.

In the third and best class, the chimney flue is reduced to a minimum, and carries off solely the products of combustion; another superior aperture discharging the products of respiration and of lamps and candles, while a free ingress of air prevents all interference of the fire-flue and the ventilating flues. This adjustment is carried still farther in some places by the union of the fire and ventilating flues, and by the provision of a sufficient local supply for the fire in its immediate vicinity, which reduces greatly the general force of the current throughout the apartment.

The above principles involve the more important bearings of the question of ventilation, so far as it affects the individual apartments in tenements occupied by the poorer classes of society, it being taken for granted that the evils arising from defective drainage, closets, and cleaning, and a bad external atmosphere, have been removed. Practically, then, a well-constructed window, capable of being opened above and below, realizes, when the fire-place is well arranged, all the essentials for effective ventilation in such apartments. Windows, however, are not recommended as affording the best means of insuring ordinary ventilation, though they may be resorted to with advantage when the weather is not severe, or under peculiar circumstances, and should therefore always be available when large supplies of air are required; but for that more minute ventilation which the system requires and tolerates in the severity of the winter's cold, and at a time when the dryness of the air promotes rapid evaporation both from the skin and lungs, a much less extended opening is required, and one capable of more minute and delicate adjustment to the ever-varying circumstances of the case, than a window can be made to command. The complaints arising from draughts and currents exist only when the movement of air becomes excessive, and is not suited to the temperament on which it impinges. The human frame is so constituted that a movement of air is perpetually sustained around it by natural causes during life. Very cold air having a very gentle movement around the person may not be offensive, while a much warmer atmosphere moving rapidly may be productive of extreme annoyance.

Taking these circumstances into consideration, with the fact that doors and windows appear generally, if not universally, to have formed no barrier against the most defective ventilation, great improvements may be anticipated when every apartment shall be provided with an independent ingress for fresh air, and an egress for vitiated air, which, though small, shall be incessantly operating, much more capable of regulation, and one which can never induce those violent and extreme changes which are produced by the occasional opening of doors or windows that may have been closed for too long a period.

In the great majority of cases where any attempt at systematic ventilation has been carried into effect in ordinary apartments, the objections which have followed its introduction appear to have arisen principally from two causes, viz., the excessive introduction of fresh cold air, or its local movement arising from cold surfaces or defective diffusion, which might have been obviated by leading in the air at any more remote part of the room, or in any position, so as to admit of the first impulse being broken by a diffusion board, or by extending the aperture of ingress along the skirting.

Another cause which appears to have retarded considerably the introduction of ventilatiou in ordinary apartments, is the idea that some special force or power is required for this purpose. It is true, indeed, that a power is required; but nature has provided this power in the movements which the warmth of the person necessarily induces in the air which it vitiates; and hence, if the natural movements of vitiated air in ordinary apartments be not opposed and resisted by the absence of apertures at those levels where air, if left to itself, will enter or escape, the discharge of vitiated air upwards by ordinary currents is as fixed and certain as the descent of water by its natural gravity in draining operations; and, if a modification be induced in apartments by kindling a fire, still, if the chimney-flue be not excessive in size, and an adequate supply be given for it, as well as for superior ventilation, these natural movements will be sustained, and proceed in harmony with the functions of the system.

Apertures such as are now adverted to may not command the extended movements that give the most complete ventilation that machinery, furnaces, and other arrangements can sustain: they may be rendered more or less irregular by the action of the wind; but, without inducing severe draughts, they will remove the extreme evil that induces so large an amount of weakness, disease, and death, and it is this result that is necessarily most important to society.

It is also important to know that mere openings operate in another way than by facilitating ordinary currents, according to the relative pressure within and without in any apartment, though this second mode of action is to be regarded principally as an auxiliary force, in respect to its power of changing the atmosphere in any apartment, however important its functions may be, where the air comes in direct contact with the living frame. So careful has nature been in the securities taken to prevent any stagnation of air around the person, that, besides the movements dependent on an alteration of the specific gravity of each successive portion of air that is received into the lungs, or brought in contact with the surface of the body, a power of penetration, revealed in modern times more especially by the experiments of Dalton and Graham, is found to be incessantly in operation, promoting natural ventilation, and discharging vitiated air from every place in which it is prone to accumulate. This force operates in every direction with a power superior to that of the pressure of the atmosphere, and its tendency is slowly to diffuse all gases and vapours through each other, whatever may be their difference in specific gravity; its action is never arrested except where air-tight barriers are interposed between one portion of the atmosphere and another. Hence, then, where internal and external temperatures approximate so closely as to reduce the movements that commonly ensue between the atmosphere within and that without, and even where they may be reversed (as when a higher temperature prevails externally than is found within), still the power of penetration between the particles of different gases or vapours never ceases to reduce the intensity with which they may be prone to accumulate in any individual place, provided a communication be maintained between it and the external atmosphere.

VENTILATION OF PUBLIC BUILDINGS.

The same defects that prevail almost universally in the public buildings in other districts are equally conspicuous in the public buildings in Newcastle, Sunderland, and other towns in the north of England. Churches with galleries near the ceiling—schools receiving vitiated air from other schools—one with vaults below it for the reception of dead bodies, and cases of recently erected buildings without a single aperture for the ingress or egress of air, beyond those which doors or windows afford, all attest that, even in this mining district, the ventilation of public buildings has assumed no regular nor systematic shape. Out of ten churches, chapels, and meeting-houses in Sunderland, two had been the subject of special arrangements for ventilation. In severe weather, the large windows in public buildings produce great severity of local currents which double glazing can alone remove.

In few places, for the most part, could ventilation be improved with greater facility than in churches. The figures in the plates indicate the more important circumstances that require attention, excepting those cases where the condition of a churchyard, or bodies placed under a church, affect the purity of the air, and prevent the appropriation of parts of churches that would otherwise often be of great value for warming and ventilation.

But in no public buildings did systematic ventilation appear to be so desirable as in schools, where the long period spent in them, as well as the age of the pupils, and the numbers so often crowded in a given space, renders them peculiarly prone to suffer from a stagnant atmosphere. It may be generally observed in schools that the atmosphere is often considered pure and wholesome by the teacher, when a stranger entering the school may perceive an impurity of which the occupants of the room are altogether unconscious. The same may be observed in all places where the atmosphere is comparatively fresh at the commencement, and deteriorates so slowly and equally that, unless it be contrasted with the external atmosphere, it often attains a state in which it renders every exertion irksome and fatiguing by the extent to which it impedes the functions of respiration, whose due operation is so essential to any continuous exertion, either of mind or body. A reference to the plates will explain the common causes of failure in the ventilation of schools, such as were observed in the northern district, and the principles on which their right arrangement in this respect depends, where no special mechanical nor heating power is used for sustaining forced ventilation. In no schools, at the period when those in this district engaged my attention, was so much illness found to prevail as in some of the schools in Durham. In the Blue-coat School there, out of 387 boys, about 60 were on the sick list; and in the girls' school, immediately above it, there were more than 20 unwell among 284. These are the numbers stated to me by Mr. George Goundry, the master, whom I requested to inform me on the subject, after I had inspected both schools, which were entirely devoid of any system of ventilation beyond what doors and windows afforded. Most of the pupils were unwell with scarlet fever, which prevailed very widely in Durham at that time. It was reported generally to have been mild, but I ascertained that in some places at least it had been very severe, two and even three deaths having occurred among young persons in individual families.

In an infant school in Durham, to which my attention was directed by Mr. Fox, 30 children out of 90 were absent from illness (scarlet fever). There were no means of systematic ventilation; a slaughter-house and a piggery were noticed opposite the principal window.

Great errors are often made in schools, where rooms intended at first only for a few individuals are crowded subsequently to an extent altogether incompatible with the original provisions made for ventilation. Cases have come under my notice in other districts where three and four times the number of pupils, for whom ventilation was originally provided, have been introduced into the school-room. Some of the schools in the northern district appeared to me to be as crowded as any I have seen in other places, and certainly the general impression which they conveyed was, that if any buildings should be subjected to inspection, in reference to their arrangements for ventilation, school-rooms pre-eminently present themselves for consideration, not only from the powerful effect which ventilation must have upon the health of pupils, but also from the influence which the maintenance of a pure atmosphere, and the example of the simple manner in which it may be sustained, must exert in disseminating widely throughout the whole community a practical knowledge of means, that are equally applicable to the habitations of the higher classes and the dwellings of the poor.

In public buildings in general, where extreme transitions, such as are observed in the Houses of Parliament and in Courts of Law, do not come into operation, it will be found that the leading objections to ventilation depend essentially on the ingress of air being too generally permitted without that nice adaptation to the circumstances of the moment which the state of the constitution may demand; and therefore, so long as proper means of diffusion are not secured, nor the supply of an adequate amount of heated air in cold weather, public buildings in the northern district cannot be expected to differ much from those in the metropolis, where so many specimens are afforded in which the principal source of heat arises from the returning currents of vitiated air, warmed by the combustion of gaseous products from lamps, candles, or respiration, and descending and ascending again and again in circling movements to the source of contamination, instead of being discharged at once, on their first ascent, to the ceiling.

INTERMENTS.

Though the question of interments was not a special object of inquiry, not being included in the terms of the Commission, while it formed a separate object of investigation with others whose attention was exclusively devoted to this subject, it is incumbent on me to state that numerous cases presented themselves where the state of the grave-yards formed a very serious subject of complaint; and to mention more particularly that at South Shields, the grave-yard had become so crowded with bodies that it was covered to the depth of two or three feet with gravel, which has in the mean time diminished the evils arising from it, whatever may be the ultimate result. It may be also proper to refer to the local report on Sunderland, where two very objectionable practices appear to prevail, viz., the deposition of bodies in vaults under a school, and the deposition of bodies in vaults adjoining a chapel, where they are not covered with mould, but permitted slowly to decay. Such practices are not restricted to the places now mentioned. From both the vaults referred to above most offensive emanations are discharged.

ACCIDENTS BY FIRE.

Accidents by fire were found to be so rare in the northern district, and to be accompanied in general by losses so comparatively trifling, that it is not deemed necessary to offer any further remarks on this subject than will be found in the local reports. The paucity of accidents by fire appear to depend on the nature of the manufacturing operations generally not being such as to involve much danger from fire, while the substantial manner in which the fire-flues of individual habitations are built reduce greatly the risk of fire from chimney-flues. In none of the towns, however, did the inhabitants appear to be satisfied with the arrangements in force for the prevention of fire; all were anxious that more systematic measures should be adopted than have hitherto been introduced. The local reports contain different suggestions on this point, several of which may be advantageously carried into operation in connexion with any more extended measures for the introduction of an ample supply of water.

The application of hose to fire-plugs, where the water is subjected to considerable pressure, has been the subject of experiment in Newcastle since my visits there, and the results appear to have been, so far as they went, very satisfactory, and much more promising than had been previously anticipated.

NUISANCES.

This question is one of much greater practical importance in the northern district than the preceding, from the extent to which nuisances prevail, and the severity with which they affect both life and property.

The most extensive nuisances are unquestionably those arising from defective sewerage, drainage, and cleansing, and these having already been the subject of remark, we shall pass to those which have not been so particularly adverted to, after stating that private slaughter-houses in crowded and populous districts, formed on the whole, the most extreme subjects of complaint, and to such an extent do they prevail, and so little are they confined to particular sites, that one of the worst cases occurs in a central street in Newcastle, or at least immediately adjoining it.

Dr. Cargill, in referring to this subject, states:—

"The most intolerable, and perhaps the most unhealthy nuisance of the many existing in Newcastle, is certainly one resulting from a slaughter-house situated in the very centre of the most fashionable part of the town. It is close to Grey-street; the nuisance consists in the presence of great quantities of animal matter, the offal of the beasts, closely heaped up in a deep narrow kind of ash-pit adjoining the slaughter-house, and these left to putrefy, until the reservoir is full, and the liquid contents stream down the lane (High Friar-lane), and fill the air in the neighbourhood with an odour so fearful that no words can express its effect. No case can more loudly call for the removal of all slaughter-houses without the limits of the town."

In ill-drained and low-lying districts slaughter-houses very often, if not always, sustain a perpetual malaria around the neighbouring habitations; they are a fruitful source of fever and other diseases, and, in short, any reference to the local reports will show their universal prevalence in towns, and a strong expression of the opinion that they ought to be subject to suitable restrictions, and placed on a new and systematic footing, such as may equally prove a pecuniary saving at last to those who use them, and relieve the public of a most offensive source of annoyance and disease.

Dense black smoke from manufactories prevails to a great extent in Newcastle-on-Tyne, at Gateshead, and at North and South Shields. These towns suffer not only from the emanations in their immediate vicinity, but also from those which they convey to each other through the valley of the Tyne, and from the numerous steam-boats that ply upon the river. In the lower parts of Newcastle and Gateshead the amount of black smoke is sometimes extremely great; and, as explained in the plates, the peculiar position of the valley of the Tyne renders it prone to retain black smoke and other offensive emanations, though a much purer atmosphere may prevail in the principal streets at higher levels.

At Sunderland, large manufactories to the west, from their unfortunate position, affect the atmosphere of the town to a considerable extent, the prevailing winds conveying the products that are evolved from their chimneys to the town. At Durham and at Carlisle, the atmosphere is comparatively free from dense black smoke; a very lofty chimney from the principal manufactory in Carlisle conveys the principal portion that is produced there to a distance from the town before it is deposited. The great causes of the production of dense black smoke are irregular and unequal firing, and the projection of large quantities of coal upon red hot or white hot fuel, where the density of the bed of cinders prevents the ingress of that amount of air which would, under other circumstances, consume the smoke, if previously heated to a proper temperature, and not deprived of too much oxygen in its progress past the fire-bars and through a thinner bed of fuel.

It is scarcely possible to watch any of those furnaces that produce the densest and the blackest smoke without observing, that its evolution is intermitting, distinct periods in general elapsing during which little or no smoke escapes. There are numerous furnaces where, when the mode of managing the combustion permits the stoker to attend to the old established rule of placing the fuel on the dead plate, between the furnace-door and the furnace-bars, a large portion of its gaseous products are discharged before it is projected on the fire-bars, and consumed in such a manner that little or no smoke is ultimately evolved from the chimney-top. With such resources alone, particularly regularity of firing, and the frequent introduction of small portions of fuel instead of the careless mode of adding large quantities at a time, great improvements may be anticipated were the ordinary stokers more frequently instructed in regard to them, and compelled (or encouraged by a small premium dependent on the saving of fuel they might thereby effect), to be much more vigilant and active in carrying them into successful execution.

From the abundance and economy of fuel, and the extreme density of smoke from some of the manufactories, less attention perhaps has been paid in this district to the means of preventing smoke, than might have been otherwise anticipated; revolving grates, machinery for feeding the fire, a blast of air, whether induced by machinery or a flow of steam, vibrating furnace-bars, and many of those endless variations in the ingenious contrivances that have been suggested, for preventing smoke, including the use of coke or anthracite, were not expected to be favourable objects of attention among manufacturers in a district where the presence of smoke has been so long proverbial.

Of other nuisances prevalent in the northern district, the most marked and offensive are those from the discharge of acrid acid fumes produced in manufacturing operations, and those developed in Prussian-blue manufactories and other similar establishments where animal matter is subjected to heat in various chemical operations.

It may be assumed from the nature of the manufactories along the banks of the Tyne, that from 20 to 50 tons of muriatic acid gas are evolved daily. Latterly a portion of this acid has been condensed in some manufactories and discharged into the river, instead of escaping into the external air. When largely diluted it may be considered rather as beneficial than injurious, if thrown into a river at a point where it is charged with animal and vegetable refuse. Its final tendency is to unite with potash, soda, lime, or any similar substance that may not previously have been combined with an acid. When muriatic acid is discharged into a stream too small to afford the requisite dilution, it may not only prove highly injurious from its corrosive qualities, but tend to render the water hard by dissolving lime or other earths.

The muriatic acid gas now under consideration is the same material which has long been familiarly known under the name of spirit of salt, when combined with water and condensed into the liquid form. It is eminently acrid, and corrosive of animal and vegetable matter; has a great attraction for water, and tends ultimately to fall in combination with it in exceedingly minute drops, if not diluted to such an extent as to be dissipated in the external atmosphere. This deposition is similar in quality to the corrosive spirit of salt, though it may be associated with a much larger quantity of water than exists there, and vary indefinitely in its corrosive power according to the relative proportion of acid and water. The nuisance is by no means confined to the banks of the Tyne, but may be traced generally in all great manufacturing districts. Its vapours are suffocating, even when largely diluted, and may often be traced at the distance of miles from the manufactory where they are evolved.

The extent to which these vapours produce injurious effects on the banks of the Tyne may be gathered from the great extent to which they have been the subject of legal investigations, and from the fact that an association of farmers and landowners was formed for obtaining compensation for the injurious effects produced by this acid upon the neighbouring vegetation.

Muriatic acid is as injurious to health as to vegetation. But the difficulty of dealing with this question in many cases, where the labouring classes are largely dependent on such manufactories for employment, will be abundantly obvious; and in South Shields, the curious anomaly is presented, however natural it may be under the circumstances of the case, of a public meeting having been called at which the inhabitants declared themselves in favour of certain manufactories from which this nuisance proceeds.

Similar feelings are necessarily entertained, to a greater or less extent, in respect to all nuisances arising from manufacturing operations, where a large population is dependent on them, and point out equally the difficulty that must often attend the obtaining of evidence, however strong the case may be, and the necessity of some neutral and impartial authority examining into the circumstances of the case.

It is fortunate, however, that this gas may be condensed very effectually by streams or showers of water, particularly if charged with lime or chalk, and that processes have been successfully instituted which hold out the prospect that, when a larger experience shall have given more minute information as to their operation, those who suffer from this cause may expect to see this source of nuisance more effectually obviated, and the manufacturer permitted to continue his labours with less injury to the health either of his workmen or his neighbours.

The other nuisances that are most frequently the subject of complaint arise from glue and Prussian-blue manufactories, where, to use the terms in which the latter are commonly described, "they burn horses' flesh and bones, and boil blood."

Tanneries, also, are frequently the subject of complaint, more especially when the tanks are emptied into open sewers. The following statements embody the complaints of six out of twelve men, taken without any special selection from the flax-spinning mills of Messrs. Clark, Plummer, and Co., who employ about 70 men and 180 women. The other six, of the twelve to whom questions were put, did not suffer so much from the state of the external atmosphere around their dwellings, except where open sewers, or the total absence of sewers and drains, added additional impurities to the external air.

1. "Complains much of the open sewer in front of the house, especially when the tanneries above open their tanks."

2. "Complains of the Prussian-blue factory and boiling blood. His wife had typhus fever two years ago, and has been sickly since."

3. "Is in bad health; had fever six mouths ago, and complains much of the open sewer in front of the house."

4. "Has a wife and eight children, and is often forced to shut the door and windows in consequence of the smell of the glue and Prussian-blue manufactories."

5. "Is married, and has a family; his wife is unwell, very much so

when the wind blows from the Prussian-blue manufactory, and he is forced to keep windows and doors shut."

6. "Has a wife and six children, the age of the oldest is 15; his wife is delicate, and complains of the damp in the house, and of difficulty of breathing at night. Water from the tanneries filters into the house."

These details have been forwarded to me by Mr. Wilkinson, who was kind enough, at my request, to make an inquiry into this subject after I had noticed the condition of the atmosphere. As many of the habitations subject to such nuisances from manufactories are also oppressed with the deleterious emanations arising from defective drainage, sewerage, and cleansing, a great anxiety to exclude the external air is a very natural consequence; and difficulty of breathing in such examples may be produced as much by a deficiency of oxygen and the presence of carbonic acid, arising from respiration, as by the direct action of noxious products that may have entered from without.

The importance of controlling all such manufactories will not be questioned when they are surrounded by densely-crowded habitations, independently of the annoyance which they may give to those at too great a distance to be seriously affected by them. The illustrations given in the plates show the manner by which all offensive emanations arising from such manufactories may be effectually consumed.

The only other cause of nuisance which it is necessary for me to advert to in this place are lead-works, which are mentioned by Mr. Newton in the following terms:—

> "There is one source of disease which I should like to see removed, that is the lead-works. This is a source of great expense to the rate-payer, and of incalculable suffering to numbers of the poor, who become, in consequence of paralysis, permanently disabled, and are cut off. We see the poisonous effect of this agent in all its forms."

EXPLANATION OF THE PLATES.

In the following illustrations, it is endeavoured, by the use of pink and blue colours, to convey a more precise idea of the movements of air in ventilated apartments, of its stagnation in others, and of the motion of air in ordinary rooms. Among a great mass of society, to whom the question of ventilation ought to be most interesting, so little knowledge exists as to the nature of the atmosphere, and of the evils that arise from neglecting its relation to the human frame, that too much attention cannot be paid to any means which may assist in rendering its influence more easily intelligible.

Pink Ink indicates fresh air, and
Blue Ink indicates vitiated air.
Purple tints, produced by the intermixture of the others, show the mixture of the fresh and vitiated air.

It may also be proper to remark, that as these illustrations are intended to point out leading considerations, mere details of adjustment have been sacrificed in the figures, wherever it was necessary, from any interference that might have rendered less distinct the movements which they are intended to explain. In particular, it is necessary to remark—

1. That all apertures, communicating directly between apartments and the external atmosphere, are supposed to be controlled by valves.
2. That all ingress apertures terminate in diffusing surfaces proportionate to the effect which it may be intended to sustain.
3. That illustrations of the influence of local currents, produced by ice-cold glass, have been omitted; they can be remedied, where this is essential (in all cases it is desirable), by double windows, or moderated by transparent calico or gauze.
4. The area for the ingress and egress of air, and for the discharge of smoke, is not specified as, in old and new apartments, the ever-varying details of local structure, exclusive of constitutional peculiarities among the inmates, give an equally varying influence to apertures of the same size. As a general rule, however, it may be stated that, in a room from 12 to 14 feet square, occupied by from six to twelve persons—
   - *a.* An aperture of one foot area for the ingress of air, and one foot area for egress, may be considered sufficient in moderate weather, if they are favourably disposed for promoting the movement of air.
   - *b.* Apertures of three or four inches square will relieve such apartments of the most extreme stagnation. If such apertures work well, passing into, or near warm flues, they are as large as the majority of persons will tolerate in winter weather, unless the air be warmed previously, or well diffused at its entrance.
   - *c.* In summer weather, the opening of a window may be necessary to give the same amount of relief which the small aperture affords in winter.
   - The air, after being led into an apartment, cannot be too largely diffused, as explained by the figures, before becoming generally distributed through it.
   - *e.* A well-constructed fire-place flue should not exceed 9 by 4½ inches area, unless a much larger fire be required than is necessary for an apartment such as has been mentioned; it is presumed that smokeless fuel alone is used, if the flue be not straight; where circular flues are introduced, they may be made still smaller.
   - *f.* Valves in the chimney flue, and in the ventilating apertures, can alone secure the varying adjustments which the varying state of the constitution demands.
   - *g.* Where ventilation is sustained by forced measures, or by the continuous heat of a kitchen fire, or any equivalent arrangement introduced for the purpose, much smaller apertures are sufficient for the ingress and egress of air than are otherwise necessary; the continuity and power of action compensating for the smaller dimensions.

PLATE I.—*Illustration of a Fiery Heap, and of its proximity to a downcast Ventilating Shaft.*

Plan illustrating the extreme proximity of fiery heaps, not only to dwelling-houses, but also to the downcast pit of some mines, and the contaminated atmosphere to which they are consequently subject whenever the wind may incline in their direction. Though the mass of ashes that may have been produced in the course of a long series of years is usually denominated a fiery heap, the combustion commonly extends merely on part of the outskirts, as indicated in the figures; otherwise the magnitude of the evil would render more clearly intelligible the necessity of putting a stop to it. (See page 1.)

PLATE II.—*Illustrations of the Ventilation of Mines.*

Fig. 1 (Longitudinal Section) gives a general view of the atmosphere in goaves which have been for a long period undisturbed, and which extend in endless forms in different mines, occupying a small space in some, while in others there is good reason to believe that they extend over 100 acres. The more nearly they border on the air-passages, where a current is sustained, the larger the amount of atmospheric air and detonating mixture in proportion to the explosive fire-damp. A perpetual movement appears to take place between every crevice in the goaf and the ventilating passages without; fire-damp, or a detonating mixture passing into the latter, and atmospheric air into the goaf. When there is a sudden fall of the barometer, the contents of the goaf expand, and they effect a partial discharge into the ventilating chambers, without a corresponding entrance of fresh air into the goaf. This movement is reversed to a certain extent, and the goaf may absorb a proportional quantity of air, for a time, from the air-passages when the barometer rises. The discharge from blowers must affect all these movements, when the quantity discharged is extreme. The clear part of a goaf, from which I took this illustration, was almost inaccessible in many places, from the broken coal and other debris over which it was necessary to pass. When the safety-lamp was held in the intermediate portion, a continual series of gentle explosions took place within it, each following the other in quick succession, and being accompanied by the descent of a blue flame from the upper part of the lamp to the flame around the wick.

Fig. 2 (Section), and Fig. 3 (Plan), illustrate one of the more common positions in which the miner works, the leakage through the brattice, and the fact that the air where he works (at *a*) may almost stagnate around him, when a feeble movement only is observed in the air following the course indicated by the larger arrow.

Fig. 4 (Section) shows the comparative size of corfes used in different mines and shafts; the larger the corfe the greater the obstruction to the ventilation of the pit.

When the brattice leaks, the fresh air, descending by one-half of a shaft, escapes through the openings into the other, and impedes the ventilation to an extent proportionate to the amount of leakage.

PLATE III.—*General Illustrations referred to in the Remarks on the Habitations and Occupations of Coal Miners.*

Fig. 1 (Plan) is an explanatory illustration, showing the comparative purity of air at its entrance, and its vitiated condition as it leaves the mine. The greatest difference is observed in the amount of exertion and fatigue which the system can bear in the fresh air, and that which can be sustained by those who are always labouring in the vitiated air.

Fig. 2 (Plan) shows the usual course adopted in numerous mines, and the splitting of the local current into three different branches, which coalesce again in their progress through the mine.

Fig. 3 (Plan) will explain to those who may not have studied the minute details connected with the working of a mine, that according to local circumstances and the adjustment of valves, the miner may be placed in a brisk current of air communicating directly between the downcast and upcast shafts, or that he may be supplied with air in a current more or less languid, according to its distance from the main current, and the obstacles which it may encounter in its progress from numerous bends and turns, as well as other circumstances, particularly the interception or reduction of the power of the current by the extent to which it may be permitted to branch off into other channels. The channels 2, 3, 4, 5, 6, and 7, on either side of the main channel, are successively less and less favourable to the progress of air. Every channel, in proportion to the other channels in action, the number of miners present, and of lamps or candles, the quantity of gunpowder exploded in blasting, and the number of vitiated air-channels that communicate with it, including any addition of fire-damp or carbonic acid, becomes necessarily more and more vitiated, and more oppressive to the workmen.

Fig. 4 (Plan) illustrates one of the great objects which it is desirable to attain in the ventilation of mines, should it be practicable to make many small shafts, or a great central discharge receiving vitiated air by short air-courses from every part of the mine, shafts being sunk in greater or less number at the circumference, as at (*a*), to afford the necessary supply of fresh air.

Under present circumstances a perpetual leakage occurs from the goaf, which discharges vitiated air into the ordinary workings, where a separate exit by a pipe, or a *dumb shaft*, as it is often termed, does not remove the air from the goaf by independent channels.

The great object in fiery pits must be, to secure safety in the workings; and a central vitiated air-shaft from a goaf, worked powerfully by machinery on the surface, when its own ascending power may not be sufficient, would be assisted by the natural lightness of the fire-damp, and the workings would thus discharge vitiated air into the goaf, instead of the latter tending generally to contaminate them. The extreme importance of additional shafts for improving the ventilation of coal-mines, renders them objects of the highest practical importance. Were premiums given for the application of steam-power to the sinking of shafts, and the introduction of screws, stamping-hammers, and other apparatus, adapted for workings through soft or hard materials, the boiler of the engine being worked above ground, while the engine and apparatus descended with the progress of the shaft, the great expense of sinking shafts might be reduced.

PLATE IV.—*General Illustrations of the Progress of Air in Schools where it was found most offensive.*

Figs. 1 and 2. (Plan and Section.)—These illustrate the general progress of air, in a school in Durham, where there was a great amount of sickness, the air entering on one side, traversing the school, and finally escaping at the other side. Though a constant movement was effected by open windows, the vitiated air from the larger portion of the school was the only supply received by the junior pupils, who occupied an elevated platform. The figures are not drawn to scale, but give my recollection of the circumstances of the case as I found them on examination. The windows marked on the plan indicate those that were open.

Figs. 3 and 4. (Plan and Section.)—These point out the progress of air from a school in Sandgate, Newcastle, which formed the only source of supply to a school for junior pupils above it.

Figs. 5 and 6. (Plan and Section.)—These point out the general condition of air in schools ventilated by windows alone.

PLATE V.—*General Illustration of Fire-places.*

The figures in this plate show the usual progress of air in a well and in an imperfectly constructed fire-place, and they are introduced to show more precisely than mere verbal explanations the leading circumstances that should be kept in view in determining the ventilation to be sustained in any apartment where a fire-place is in action. Returning smoke, particularly when fires decline and the supply of fresh air is imperfect, is a frequent cause of a vitiated and oppressive atmosphere in the habitations of the northern district; but not, perhaps, to the same extent as in other places, from the more powerful fires usually sustained, and the greater moving power accordingly which the chimney-flues acquire. The greater the reduction in the chimney-flue, in proportion to the amount of fuel consumed, the less the offensive draught in the immediate vicinity of the fire-place. The greater the amount of air heated by the fire-place before entering the room, the less objectionable will its movement be in its progress through the apartment. (See pages 37 and 38.)

In figs. 1, 2, 3, 4, *a*, indicates the entrance of air by a special flue.
b, the warming chamber.
c, a porous dado, receiving the warm air and distributing it through the apartment.
d, a direct supply to the fire.
e, a moveable blower.
f, the fire-flue.
g, regulating fire-valve.
h, the ash-pit, closed at all times in front of the fire-place, except on removing ashes.

In this fire-place, iron is avoided in immediate contact with the fuel, wherever it is practicable, with a due reference to the structure of the grate.

Figs. 5, 6, 7, and 8 point out one of the most common forms of defective arrangements in the construction of grates, intended to diminish excessive draught at the fire-place; *o* indicates iron in the grate *k* to an extent that prevents brilliant combustion, and renders the fire prone to be extinguished sooner than in those cases where the fuel is in contact with bricks or fire-clay lumps; *m*, the valve, which is generally shut, and *n* the opening by which the products of combustion usually escape, the position of the inclined plane on either side favouring the discharge of vitiated air into the apartment.

PLATE VI.—*General Illustrations*—continued. *Miscellaneous Figures. Movements in the external Atmosphere. Ventilation of Gas-lamps.*

Fig. 1 points out the movement of vitiated air from a fiery heap, when the atmosphere is comparatively calm, the ascending products of combustion returning in ever-varying circles to the level of the ground, according to their temperature, and the amount which does not escape at once by diffusion into the surrounding air.

Fig. 2 illustrates the manner in which vitiated air is prone to be beaten down into the valley of the Tyne, a rapid current passing over it at a considerable elevation, without causing that change which might have been at first anticipated, and permitting it in many cases to flow at right angles to the pure air above. This movement of vitiated air may be traced in innumerable streets, lanes, squares, courts, and alleys, and often affects very powerfully the quality of air observed on one side of such places, while, on the other, the air may be comparatively fresh.

The ventilation of gas-burners may be effected by an upward movement in the manner indicated in fig. 3 (Plate VI.), where the products of combustion are represented as passing from a common argand into a chimney-flue in the manner indicated in fig. 8 (Plate VIII.); or they may be made to descend in an opposite direction, as pointed out in fig. 4 (Plate VI.), where the ventilating tube descends through a stone or other protected table to a similar flue, whose power determines the downward draught, the ascending or descending burner being modified indefinitely according to the special circumstances under which it is used and the effect which it may be intended to produce.

Considerable expense is at times incurred in the adaptation of glasses to such ventilated burners. To obviate this, the radiating burner is recommended, in which union-jets are so arranged that a powerful and smokeless flame can be maintained of any intensity almost, according to the number employed. They may be disposed in various ways, as in figs. 5 and 7, (corresponding with the plans, figs. 6 and 8). The union-jet, in which opposing currents of gas flash into a thin sheet of flame, at right angles to the plane in which the currents proceed, always gives a comparatively white light. In cases where the argand is said to be much more economical in producing light, it will be found that it has been stinted of a proper supply of air, and burns with a light more or less of a reddish hue, according to the deficiency of combustion, dependent on too small a supply or an imperfect application of atmospheric air.

PLATE VII.—*General illustrations*—continued.

The greater number of the cases explained in this and the following plates illustrate the leading circumstances connected with ventilation to which my attention was directed by members of the local committees, in examining individual apartments, already built, and give examples of the nature of the inquiries usually made during the progress of my visit, and the varied and limited measures which different individuals were disposed to adopt.

Case 1.—No ingress can be permitted at the sides, and no egress above; the common fire-place is all that is available for the discharge of air, and it cannot be pierced above the chimney-piece. An aperture may be made opposite the fire-place, but it cannot be higher than two feet above the floor.

Ans. Fig. 1 (Plan).—The ventilation will never be satisfactory if the room is crowded. The progress of the air will be directly from the ingress to the egress by the fire, at a low level; unless revolving currents at a higher level than the chimney-piece may or may not produce a sufficient mixture with the leading current below, to sustain a proper atmosphere.

Case 2.—The ingress of air can be permitted only at the same place as in the preceding case, but there is no objection to subsequent diffusion; and it is an object to sustain a general movement of air throughout the apartment, and to reduce to a minimum the strong currents in the immediate vicinity of the fire-place, such as must ensue in Case 1. Superior apertures cannot be agreed to either for the ingress or egress of air.

Ans. Fig. 2 (Plan).—The ventilation will be imperfect to a certain extent, as in the preceding case, from the want of a superior aperture. The ingress of fresh air by a flue, immediately adjoining the fire-place, will reduce, in proportion to the amount admitted there, the severity of the current impinging on any one near the fire. By opposing a board to the ingress, the entering air may be diffused to any extent around a porous skirting, according to the amount of escape that may be permitted from it at different places.

Case 3.—A single aperture alone can be permitted both for ingress and egress of air; it is required to ventilate as much as circumstances permit, no chimney being in operation, and doors and windows being too air-tight to permit of any discharge.

Ans. Fig. 3 (Section).—Let the aperture be made at the highest part, of a magnitude proportionate to the amount of discharge demanded. A current will enter in general by the lower portion of this aperture, while a corresponding current passes outwards by the upper portion. This movement will always be induced when the air in the interior of such an apartment is warmer and lighter than the external atmosphere. No ventilation, however, can be expected under such conditions, where the atmosphere within is colder and heavier than that without; the air will then remain stagnant, in the same manner as water in a well. (In this case were an aperture made below alone, then an interchange might be expected, as the warmer and lighter air would enter and ascend, displacing the colder air through the lower part of this lower aperture.)

Case 4.—Windows and doors cannot be used for ventilation, and there is no fire-place nor spare flue accessible; it is required to ventilate by natural movements a small school-room.

Ans. Fig. 4 (Section).—Make an opening under the window, and diffuse the air permitted to enter by it around the skirting in the manner described in Case 2. Let a superior aperture be made at the highest accessible part of the room, of an area proportional to the discharge required. The ventilation will be powerful or indifferent, according to temperature within and without.

Case 5.—Diffusion can be obtained extensively at the skirting. Objections are entertained against any superior aperture in the outer wall; the chimney has a powerful draught; it is required to carry off air by a superior aperture, as well as by that which the common fireplace presents.

Ans. Fig. 5 (Section).—Pierce the chimney in the upper part of the wall, near the ceiling; let the aperture be defended from fire or heated air, and capable of being shut absolutely air-tight by a metal valve, which can be so securely fixed in its place as to prevent all return of heated air on any extreme occasions when this may be apt to take place, or such recoil as may ensue when the fire declines, and becomes nearly extinguished, and the power of the chimney is proportionally reduced. Let a copious ingress of air be always maintained, so as to satisfy the demand of the fire-place and of the discharge by the aperture near the ceiling. Though the chimney has a powerful draught, the ventilating aperture will work well or indifferently, according to the supply of air, and the temperature within and without.

Case 6. Fig. 6 (Section). If the supply of air be too small, though it may be traced entering at the proper aperture; if the fire be too strong, and the opening immediately above the grate be uncontrolled by a valve; and still more, if the aperture near the ceiling be too large, then a dangerous recoil is prone to ensue, as indicated in fig. 6.

This in reality is only a variety of one of the most common movements of air when back-smoke vitiates the atmosphere of any apartment.

Case 7.—A cellar is provided with a fire-place; no diffusion can be permitted at the sides below, from the manner in which they are occupied; the fire-place is indifferent, and very apt to smoke, from the manner in which the chimney-top is exposed to local external currents; a fire is in constant use. It is required to obviate the recoil from the chimney, and to provide suitable ventilation.

Ans. Fig. 7 (Section).—Let the opening between the top of the fire and the chimney-piece be diminished as much as possible, and admit air at a superior aperture, diffusing it on entering at the ceiling.

Case 8.—It is required to sustain at all times a steady and uniform ascending current through an apartment, where it is important not to admit air at the level of the ground, and where it is impossible to apply mechanical power, or to carry an elevated chimney to any considerable height above the level of the ceiling.

Ans. Fig. 8 (Section).—Let air be taken in by an opening at the highest accessible altitude; let two tubes be formed within the apartment, the first to convey the air from the ingress to the floor, where it may be diffused to the desired extent, and the second to convey it from the ceiling to the fire-place, F, where a gas-light, a fire, an oil-lamp, a steam-pipe, a hot-water coil, a stove, or any other source of heat may be applied to sustain, without interruption, the required movement.

Plate VIII.—*General Illustrations*—continued.

Case 9.—It is required to introduce warm air into an apartment, and no means are to be allowed beyond those that can be introduced in the structure of an open fire-place.

Ans. Fig. 1 (Section), and Fig. 2 (Plan).—Let the fire-place be constructed in such a manner that air, entering from without, must necessarily pass across warm bricks, or through any chamber provided in forming the fire-place, before it enters the body of the room.

Very complete arrangements for effecting this have been introduced in many grates, and have been sometimes combined with the general ventilation of the apartment. (See Plate V.)

Case 10.—It is required, in an ordinary apartment, where the chimney-flue cannot be touched in consequence of a tendency to smoke, to combine the advantages of a superior discharge with those of an open fire-place, reducing the current in the vicinity of the fire-place to as great an extent as may be practicable.

Ans. Fig. 3 (Section).—Let a free ingress for general ventilation be permitted, with all the diffusion that circumstances will permit; let a separate supply of air be given in the immediate vicinity of the fire-place, as ample as the fire can consume, allowing for the great expansion which the air undergoes in its progress to the chimney; let the open space between the chimney-piece and the grate be reduced as much as is compatible with a free use of the fire; let the valve in the chimney-flue (immediately above the chimney-piece), close to this flue as much as is consistent with the removal of the products of combustion, and the power with which it may be required that the fire shall burn; by a spare flue, or some other superior aperture, let the vitiated air be carried off above and discharged, but not in the immediate vicinity of the chimney-top, where the fire-flue terminates.

Case 11.—It is required to ventilate powerfully one end of an apartment near the fire-place, but to sustain the atmosphere in the rest of the apartment with no more ventilation than that which is induced by the more gentle and secondary movements that are consequent on indirect ventilation.

Ans. Fig. 4 (Plan).—Let the ingress be so arranged that the direct progress of the air between it and the discharging fire-place shall involve the space where the greatest ventilation is desirable. The movement is less in every other portion of the apartment, according to its distance from the leading current, and may be proportionally charged with bad air.

Case 12.—The ventilation effected by crevices in doors and windows is as much as can be permitted; every thing would be satisfactory were it not for the occasional return of vitiated air from the stove.

Ans. Fig. 5 (Section); and Fig. 6 (Plan).—Permit a larger ingress of air, so that the stove may have a sufficient supply, or adjust valves so as to prevent return; and, if it should be required to dispense with valves altogether, and to sustain an atmosphere perfectly free from all return, let an opening be established to supply the stove with fresh air from without, so that at times, however feeble the current may be, any returning movement shall neither arrest the progress of combustion nor be the cause of any ingress of vitiated air into the apartment.

In stoves, constructed in this manner, the products of combustion, except where the fire is kindled or fed, may be considered as hermetically excluded from the apartment. In many buildings in northern countries they are kindled and fed from without, where there are appropriate corridors or passages.

Case 13. Fig. 7 (Section).—The ascending products of combustion from gas-lights cause a corresponding descent of vitiated air, with which the head and superior extremities may be surrounded, though the feet are bathed in a cold atmosphere. It is required to carry off these products, so that the air shall be no more contaminated by them than if they were not formed within the apartment.

Ans. Fig. 8 (Section).—Let a superior ventilation be established to such an extent as to involve and carry away all the products of combustion, or let burners be arranged in such manner, or provided with appropriate tubes, securing them as effectively as a good chimney-flue withdraws the products of combustion from a common fire.

PLATE IX.—*General Illustrations*—continued.

Case 14 (Fig. 1).—Perpetual headache is observed in the lower and inner apartments of houses forming part of a court, surrounded on every side by lofty buildings, and accessible only by a very narrow entrance.

Ans.—This case is incurable, except by opening the court so as to admit of free external ventilation, or by supplying these lower apartments with air by channels from without the court; for, except on those occasions when a comparative calm permits the free and slow ascent of products of combustion from surrounding chimneys, the court is always subject, in whatever way the wind may blow, to the precipitation of these products, whether visible or invisible, passing currents causing them to descend on one side, while they ascend and escape on the other. Endless modifications of such movements may be observed, and very marked instances of long-continued headache, oppressive debility, and lowness of spirits, have been traced to those causes.

Case 15. Fig. 2 (Section).—Two school-rooms are heated by a common stove; the upper one is subjected to a local current of great intensity, which dashes rapidly to the ceiling as it passes; the lower school gains little benefit from the stove, except the radiation from the external surface below, giving local intensity, instead of a general and equal warmth.

Case 16. Fig. 3 (Section).—This case indicates an arrangement, of a much more complete and effective nature, both for economy of fuel, and for the supply of air in one of the simplest forms of schools. From a horizontal stove, an iron tube traverses a fire-proof air chamber, terminating in an upright chimney, the stove being constructed in the same manner as Dr. Arnott's, so as to give extended surface, with moderate temperature. Air entering from above descends at a distance below the level of the stove, before it escapes into the general air-chamber. Diffusion at the sides reduces all severity of currents, and a valve in the central discharging aperture above regulates the amount of movement.

Case 17. Fig. 4 (Section).—This case represents a school-room, and the house of the schoolmaster below it, warmed by a central stove in the passage, the influx of air being at all times open so as to afford an ample supply, the amount of movement through the school or the apartments below it being regulated by the adjustment of valves in the discharging apertures.

Case 18. Fig. 5 (Section).—This figure indicates the adjustments for an infant school, where it is required to supply warm air by the rising steps, cold air from the opposite end of the school, or cold air from both ends at the same time, according to the state of the external atmosphere.

Case 19. Fig. 6 (Section).—Indicates the discharge of carbonic acid, such as was observed in one of the apartments referred to in the local Reports. (See page 11.)

PLATE X.—*General Illustrations*—continued. *Ventilation of Schools.*

Case 20.—Three school-rooms, accessible by a central external staircase, are destitute of all means of ventilation; it is required to introduce the most simple and economical arrangements that are practicable for relieving them of the severe evils to which they are subjected.

Ans. Fig. 1 (Section).—Make openings (*a*) (*a*) (*a*), capable of being controlled by valves, and let the entering air, instead of bursting abruptly inwards, be forced into a channel of diffusion, formed round the skirting. The entrance alone may be sufficient, breaking the impulse of entering air by a board placed before it, if the porous skirting cannot be provided.

Construct three separate discharging-tubes (*b*) (*b*) (*b*), proceeding from the ceiling of each apartment, the escape of vitiated air through them being controlled by valves, which may consist merely of wooden flaps, elevated or depressed by a cord.

Case 21.—In another series of three school-rooms, not ventilated by any means, it is found that there are three spare flues, one to each. No openings for the admission of air can be made in the external walls; no diffusion can be given at the skirting.

Ans. Fig. 2 (Section).—Supply the staircase freely with air from without, put a porous panel in the doors, or frame doors altogether porous, break into a spare flue immediately under the ceiling of each room to be ventilated, and place a valve there to control the escape of air. Cut off all connection between these flues (*b*) (*b*) (*b*), and any other apartments. If the stair be lighted with lamps, let all products of combustion pass, as indicated, into a separate flue.

Case 22.—Three schools require the simplest ventilation; no openings can be made in the external walls; only one external discharge from them all, and from the stairs, can be obtained.

Ans. Fig. 3 (Section).—Supply the staircase freely, as in the preceding case; make one external discharge (*b*) sufficiently ample to receive three independent branches (*c*) (*c*) (*c*); let valves there regulate the flow of air through each class-room, and let the stairs be provided with porous doors to break the force of the entering currents.

PLATE XI.—*General Illustrations*—continued. *Ventilation of Houses.*

Case 22. Fig. 1 (Section).—A house is filled with vitiated air from products of respiration and combustion, drains, and back smoke. The rooms in the upper story afford the principal supply of fresh air by their chimneys, no other source being open. The great consumption of the kitchen enables it to draw largely from the passage, which again receives its supply from the rooms above. While these more general movements proceed in the manner indicated by the arrows, local currents are developed in the other apartments by lamps and fire-places, as well as by individuals respiring the vitiated air, and these are also indicated by the arrows. It is required, during the progress of alterations, when the house is nearly rebuilt, though the same general arrangements are retained, to make provision for such movements of air as can be effected with the aid of a single stove, and a gas-lamp in the channel for discharge.

Ans. Fig. 2 (Section).—Let an Arnott's stove, or any equivalent apparatus, be placed in the lower part of the staircase, and let air enter so freely, that it is continually flooded with a warm atmosphere, tending, from its warmth, to escape upwards wherever an aperture is permitted. Establish communications between the passage and each apartment to be ventilated; let them not open abruptly into the apartment, but with such diffusion as may be required. Let valves and appropriate channels regulate the discharge from each apartment; let them all unite in a general hot-air chamber in the roof, and let an additional valve control the general discharge. Let the drains be trapped, and a ventilating flue receive such products as might otherwise be discharged into the rooms.

PLATES XII. and XIII.—*General Illustrations*—continued. *The Atmosphere of Churches.*

Case 24. Fig. 1 (Section).—A church has no warming apparatus, no systematic means of ingress or egress of air beyond doors and windows; local currents prevail so extensively in winter from cold glass, even when doors and windows are shut, that the greatest objections and prejudices are entertained against any supply of air. Children in a second gallery respire only the vitiated air proceeding from the body of the church and the lower gallery; they find it impossible to command their attention from the state of the atmosphere, particularly during the evening service, and when the lamps are lighted. A new church is to be constructed of similar dimensions and accommodation; it is required to place the ventilation on such a footing as may be compatible with the least possible alteration of the design.

Ans.—Fig. 2 (Section) shows one of the simplest modes of making the necessary arrangements. The lowest part of the tower admits fresh air at A, to the chamber B B, which is appropriated to the general diffusion and supply of air, as well as to the communicating of the necessary warmth in winter. Flues from B to C C supply the chambers under the galleries with fresh air. The body of the church is supplied through the passages; separate channels, M M, give a special supply to the pulpit. D D are exclusive gas-burners, discharging the products of combustion by a pipe, E, in the vitiated air-channel F F. The valve G regulates the discharge into the upper part of the tower, being worked by the cord H H. The vitiated air escapes on one or more sides of the tower, as at L L, according to the state of the atmosphere.

Figs. 3 and 4 (Sections) illustrate varieties in the mode of supply and discharge where there is no tower, and where difficulties prevent a free communication between the air-chamber under the floor of the body of the church and the chambers under the galleries, which are represented in fig. 3 as deriving their supply from the external atmosphere.

PLATE XIV.—*General Illustrations*—continued. *House of Refuge.—(Night Asylum.)*

Case 25. Fig. 1 (Longitudinal Section).—Those occupying the beds near an open window complain bitterly of the current of cold air which pours directly down upon them. This current, after passing over those occupying the other berths on the floor, forms the only supply given to those occupying the upper floor. The air escapes from one ventilator in the ceiling of the upper apartment into an ice-cold roof, where local eddies often return a portion of the vitiated air, the rest being discharged above. It is required to make a better arrangement with such limited means as are available for the purpose.

Ans. Fig. 2 (Longitudinal Section).—Let air be permitted to enter by louvres at the staircase, where it shall be at the greatest possible distance from the nearest sleeping-berths. Let any small stove, or other source of heat provided, be placed on the floor at the foot of the stairs, if practicable, and let a porous texture, at a short distance from the louvres that permit the entrance of air, give still greater diffusion, and break the force with which it enters. Nothing does better for this purpose than the very cheap material on which paper is usually pasted, where it is not fixed directly on the wall, and which is commonly sold under the name of *scrim* in London. Provide a separate discharge of vitiated air from the lower room, connect it with the discharge from the upper room by a tube terminating in the external discharge on the roof. Let two valves be provided, by the due management of which the circulation in each room may be regulated.

PLATE XV.—*General Illustrations*—continued. *The Atmosphere in a badly Ventilated Factory.*

Case 26. Fig. 1 (Section).—The atmosphere in a crowded factory is offensive in every place from the perpetual influx of gaseous products from a large cesspool, which never ceases to discharge its noxious emanations through openings in the seats provided on every floor for the convenience of those at work. The air, passing through open windows in the staircase, is subject to perpetual fluctuations, sometimes entering, and at other times passing outwards, according to the inclination of the wind and the state of the atmosphere within the factory. It is required to correct this source of nuisance and oppression.

Ans. Fig. 2 (Section).—Establish a communication between the upper part of the cesspool and the furnaces of the boiler; or, if the chimney be powerful, the communication may be led directly into it. Make small openings in the upper part of every closet, and if no apparatus be provided at the seats, let the channel be sufficiently large to command a descending current from every closet. Let the windows in the staircase, the doors there, and the doors to the closets be at least so far opened as not to prevent the effective operation of the discharging flue from any deficient supply of air. Cut off all communication between the descending soil and air-pipe and the external atmosphere, excepting such as is maintained through the under-ground flue. The illustration given does not extend to any systematic means of ventilation, though it would not be difficult to connect this with the means employed were the soil-pipe conveyed directly downwards into the cesspool, the air-passage being made large, as represented in the figure, so that the general ventilation might be assisted by the extent to which the closets are made a channel for the escape of air. In manufactories, however, in general, the ventilation necessary is so dependent on the nature of the materials used, the operations carried on, and the numbers crowded in a given space, that this illustration is not intended to apply to the subject generally, but rather to the specific evil pointed out, which, in numerous cases, is one of the principal, if not the leading cause, of the vitiated air which prevails in them.

PLATE XVI.—*General Illustrations*—continued. *Ventilation of Factories where Mechanical Impurities contaminate the Atmosphere.*

Case 27.—No sources of impurity in the atmosphere lead more frequently to fatal and injurious consequences than those where siliceous or metallic dust is suspended in the air, and is inhaled during the process of respiration. The movement of air can be commanded with facility in any direction; it may be made to ascend or descend, or to pursue any lateral course that may be required. It is as easy to lay hold of and withdraw, by suitable arrangements, any atmospheric impurity at its source, as it is to direct a stream of water with a flexible hose upon any point where it may be desired that it should impinge. The figures in Plate XVI. indicate the general disposition and arrangements most desirable for one of the severest cases of injury from mechanical impurities, namely, that which is presented in the preparation of mill-stones. The French burr-stone, of which they are made, is a cellular horn-stone, which, at every stroke of the chisel, gives off a cloud of siliceous dust, which, when respired in the usual manner, along with the atmospheric air in which it is suspended, injures the lungs and produces early death in proportion to the extent of the exposure. No cases are more melancholy than those that may be observed in such manufactories. Thus the preparation of the means for reducing to an accessible form the principal necessary and support of life, brings disease and premature death to those engaged in this operation.

Fig. 1 (transverse section), fig. 2 (longitudinal section), and fig. 3 (plan), show the ingress of fresh air by (*a*), the vitiated air-channels (*b*), the individual apertures (*c*), which convey the siliceous dust to the ventilating tubes (*f*), the ventilating shaft (*d*), and an opening into it regulated by a valve for the general ventilation of the workshop.

Fig. 4 shows a special ventilating tube (*a*) for withdrawing the siliceous dust produced in dressing the mill-stone, resting on the support (*b*), after the pieces of which it is composed shall have been joined together.

Fig. 5 shows the general arrangement of the ventilating shaft (*f*).

A hot-water apparatus (*a*) (*b*) (*c*), commanding the necessary draught in winter, and heating the air that supplies the workshop; (*g*), a more powerful fire to be used in warm weather, and in all cases when the ventilation by the hot-water apparatus may not be sufficient.

Plate XVII.—*General Illustrations*—continued. *Application of a Decomposing Furnace.*

The figures in this illustration point out the manner in which a decomposing furnace may be applied, not only to particular boilers, pans, or cisterns, but also so as to control the emanations from all stores and the general atmosphere within the manufactory, so that nothing whatever shall escape from it except the ordinary products of combustion. It is considered that when the facility with which such arrangements can be carried into execution, as well as the perfection which they have attained, and the endless adaptations of which they are susceptible, become more generally understood, the amount of nuisance both within and without numerous factories will be greatly diminished, and that there will be less hesitation in enforcing the existing laws against nuisances in towns and populous districts where no attempt is made to reduce great and acknowledged evils.

Plate XVIII.—*General Illustrations*—continued. *Apparatus for Condensing or Decomposing noxious Emanations, not destructible by a red-hot Fire, with access of Atmospheric Air.*

The varieties of apparatus and materials available for this purpose differ as much as the circumstances under which they require to be applied.

Fig. 1 shows the progress of fumes through porous or broken solids by which they are condensed and retained.

Fig. 2 illustrates another mode of proceeding, the fumes being decomposed, condensed, or changed into new products, by passing over materials disposed in trays, descending in the form of a shower, or discharged in the form of vapour escaping from a steam-pipe, by which they are so chemically altered as to be no longer injurious.

Fig. 3 shows the application of a material in the liquid form, where valuable products are condensed, and where mechanical means are applied to sustain the current, instead of a draught produced by fire or steam. The screw, the fan, the pump, the bellows, or the precipitation of water, may be used in effecting the necessary movement, machinery being applied, according to the magnitude of the operations necessary.

Plate XIX.—*General Illustrations*—continued. *Ventilated Steam Baths.*

These figures point out the general arrangements necessary for ventilated steam and shower baths.

It is considered that in many places the most effectual and economical ablution may be obtained by the introduction of steam-baths, especially where water is expensive. A limited supply of warm water, at a proper temperature, is provided so as to afford a shower-bath, the occasional use of which during the progress of the steam-bath renders cleansing and the use of the flesh-brush much more convenient than in the ordinary water or vapour baths,

PLATE XX.—*Explanatory Illustration of the Ventilation of Isolated Cottages.*

The great object, so far as ventilation comes into play, is the supply of fresh air, in such a manner that its impulse shall be broken and its temperature elevated to a greater or less degree, according to the facilities which may be afforded by the action of a single fire.

The different figures show plans and sections, illustrative of considerations founded on experiments that have been continued for the last 12 years, though applied principally, in the first instance, in connection with flues used for furnaces adapted to chemical operations. In these experiments it was found that a flue, 9 inches square and 17 feet high, could command four fire-places, each sufficiently large for any ordinary apartment, were no air permitted to pass into the flue beyond what was requisite for the combustion of the fuel. As a general rule, a preference is given to a flue 9 × 4½ inches area, for a room about 12 feet square, smokeless fuel being used, and the flue never requiring, accordingly, to be swept. (See p. 48.)

A hot-press over the fire, and the low position of the fire-place, form a substitute for the accommodation usually provided in the more open fire-place. The warmth of the brick-work surrounding the fire-place was found to be so considerable, that small ventilating apertures, from 2 to 4½ inches square, were freely used at different elevations above the fire-place. But, in the adaptation of arrangements for a cottage, the use of brick-work made in large pieces, so as to present the various apertures required, and in some cases the use of a cast-iron tube, or of tubes made of strong earthenware, and arranged so as to be defended and supported by the surrounding structure, afford advantages which are multiplying daily the facilities of structural arrangements.

Fig. 1 (transverse section) shows the ingress of fresh air to the space surrounding the fire-place, and a channel for permitting the air, warmed by coming in contact with the brick-work, to ascend to the rooms above. On the other side of the fire-place is a receptacle for coals, and beyond it a closet, communicating by the most simple form of a trap with a drain-pipe, which may be constructed of strong earthenware, well coated with pitch, or any other tight adhesive substance, so as to render it impervious to moisture or to gaseous products from the decomposition of the refuse it contains. It is presumed that a water-cistern, and a valve or cock upon the supply-pipe, give at all times the necessary supply of water, wherever such conveniences are introduced.

Fig. 2 (longitudinal section) shows the arrangement of the fire-place and hot-press above it, with their openings into the main flue, the one for smoke and the other for the purpose of carrying off any products that might prove offensive if allowed to escape into the apartment. Behind the fire-place is a space formed in the brick-work of the lower part of the shaft, where the air admitted to supply the apartments may receive such an amount of heat as may be attained by its contact with the warm brick-work.

In this and the preceding figure the smoke-tube is indicated in the centre of the shaft, surrounded by the vitiated air which escapes from each apartment by an opening near the ceiling, and which receives from its contact with the smoke-tube an amount of heat that increases its ascending power. While the smoke-tube passes directly through the roof with sufficient protection to any combustible material, the vitiated air escapes by openings at a lower level, protected from the weather. Valves regulate the amount of discharge from each apartment.

Fig. 3 shows a plan of the ground-floor, with the base of the central chimney and the arrangements around it. The closet is situated in proximity to the kitchen and scullery, so that the refuse water may be made to pass through it in its progress to the drain, and sufficiently near the chimney to ensure the constant discharge of vitiated air from the ceiling. A closet so arranged does not discharge vitiated air into the cottage generally, but rather derives its supply from it. And, though the introduction of a closet in so small a cottage, and where space is so valuable, may appear to some questionable, still, in a medical point of view, as well as for other reasons, nothing contributes more to health and comfort than the provision of such a convenience within a cottage, when it can be well drained, well ventilated, and sufficiently secluded.

Fig 4 shows a plan of the upper floor, divided into small apartments, it being considered better that separate ventilated sleeping-berths should be provided, however small, than that one large apartment should be used, common to a number of individuals. It will be observed that, while a good foundation is secured for the central shaft, the wall at different places is so arranged as to comunicate a certain amount of heat to the principal apartments on the ground-floor, as well as to communicate a moderate warmth to the stairs and the sleeping-rooms above; and, though this cannot be expected to operate with any great force in severe weather, it will at all times tend to temper the severity of the air which may enter, and to promote ventilation.

Plate XXI.—*General Illustrations*—continued. *Progress of Air in Ventilated Apartments.*

Fig. 1 indicates progress of very cold air entering an ordinary apartment at the skirting, and proceeding to the fire-place, the air in the rest of the apartment being very little affected.

Fig. 2 shows a different movement, the valve of the fire-flue being closed so as to diminish the amount of air conveyed there, and a superior opening discharging vitiated air at a higher level.

Fig. 3 points out the more equal movement of warm air entering by the skirting and proceeding to a central discharge, no fire being in action to determine a local current.

Fig. 4 indicates the progress of air entering under the same circumstances as in Fig. 3, excepting in so far as this progress is modified in consequence of its being at a lower, instead of a higher temperature, than the air previously in the apartment.

Figs. 5 and 6 give examples of a still more equal movement of air, such as has been occasionally introduced in apartments for invalids. The porous ceiling in fig. 5, and the porous cornice in fig. 6, effect this object, particularly when assisted by a deep and porous dado.

In applying the preceding illustrations, it will facilitate much the consideration of individual cases, if it be recollected that the ventilation which is most suitable to different individuals is greatly modified by numerous circumstances, among which the following may be noticed as more deserving of general attention. Details might be indefinitely multiplied, but the more leading considerations alone require attention in this place.

Tabular View of Circumstances affecting the Supply of Air necessary for different Individuals in any Apartment.

I. General.
  1. Climate.
  2. Season.
  3. Time of day.
  4. Condition of the external air.
    a. Temperature.
    b. Hygrometric state.
    c. Electric state.
    d. Direction or force of the wind.

II. Local.
  1. Natural position of the apartment under consideration.
    a. Aspect in reference to the rays of the sun.
    b. On a mountain ridge.
    c. In a valley.
    d. Proximity to the sea.
    e. Position in respect to any other collection of water, or moist surface, including the nature of the emanations from it.
    f. Condition of the soil, and vegetation in the vicinity.
  2. State of the drainage, natural and artificial, especially if unventilated drains discharge vitiated air in the vicinity, or in the apartment occupied.
  3. Form of the building in which it is placed, particularly in so far as it is favourable or unfavourable to external ventilation.
  4. Influence of mechanical or chemical impurities from manufactories, or deficient cleansing.
  5. Position in towns in respect to smoke or prevailing winds.
  6. State of the cleansing, particularly as affected by supplies of water.

III. Special.
  1. Quality of air supplied from without.
  2. Mode of adjusting quantity supplied to varying circumstances requiring attention.
  3. Treatment to which the air is subjected.
    a. Heating.
    b. Drying.
    c. Moistening.
    d. Purifying.
    e. Velocity of movement.
    f. Amount of diffusion at its ingress.
    g. Position at which vitiated air is withdrawn.

4. Peculiarities of apartment.
    - *a.* Altitude.
    - *b.* Materials of which it is built.
    - *c.* Position of door and windows.
    - *d.* Single or double windows, or glazing.
    - *e.* Influence of furniture or other materials.
    - *f.* Natural inclination of currents or eddies within the apartment.
    - *g.* Mode of lighting.

5. Crowding.
    - *a.* Numbers on a given space.
    - *b.* Their position within or without the zone of each other's respiration.

IV. Personal.
  - *a.* Condition of the system at the moment, particularly as exhaling to the external atmosphere, or absorbing from it in a greater ratio than is compensated by exhalation.
  - *b.* Temperament.
  - *c.* State of health.
  - *d.* Age.
  - *e.* Habits.
  - *f.* Nature of diet; time that may have elapsed since any refreshment may have been taken.
  - *g.* Clothing.
  - *h.* Exercise taken.
  - *k.* Relative amount of pulmonary or cutaneous exhalation.*
  - *l.* Previous exposure.

V. Dependent on occupation, nature and amount of labour, in professional engagements, trades, and in positions where peculiar emanations require to be guarded against.

This department is so extensive that very leading considerations can alone be included in the following summary.

a. Inequality of clothing, and use of non-porous clothing.

When the professional engagements, or other circumstances, lead to inequality of clothing, particularly where wigs and gowns give unusual protection to the head and the body generally, while the feet may be comparatively unprotected, it is impracticable, in crowded assemblies, to place the ventilation on the best footing, both for individuals in this position and for others not so circumstanced, unless special arrangements be made to meet both cases.

Similar considerations apply in innumerable cases in the habitations of the poor and the dwellings of the rich, modified by an endless diversity of details, but all agreeing in the obstacles presented to ventilation by the imperfect protection of the feet which the nature of the climate requires, where it is not obviated by the introduction of warm air, or the proper diffusion of cold air. Soldiers wearing brass or steel helmets, large boots and gloves, and other non-porous or imperfectly porous clothing, may be often seen suffused with perspiration on the face, the escape of which is so much obstructed from other parts of the body. Cases of death are recorded where non-porous clothing is still more largely used.

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* Some individuals exhale almost exclusively by their lungs, while in others the pulmonary exhalation of moisture at least is altogether trifling, compared with what is discharged by the body.

b. Extreme and rapid transitions of temperature.

These tell more severely upon many constitutions than almost any other cause. While all persons are subject to such transitions in passing between the external air and ordinary apartments, it is in chemical manufactories more especially that their more severe operation is experienced. Common sailors are more exposed to extreme transitions than other classes of persons, being often called to leave their hammocks, where they are surrounded with hot and vitiated air, and to expose themselves to the most chilling blasts.

c. Mechanical impurities.

These are of very great variety, according as they proceed from the general atmosphere of any town or district, or from any special materials communicated to the air in manufacturing operations. Those evolved in grinding metals and in making flour mill-stones present extreme cases of the fatal results that ensue where effective ventilating arrangements are not adopted. The dust from vegetable and animal matters is often highly offensive, but rarely so deleterious as in the examples now mentioned.

d. Chemical impurities.

These are by far the most abundant and frequent sources of impure air in ordinary apartments, in public buildings, in manufactories, and mines. The following list contains a notice of the more extreme cases in which suffering, special disease, or general bad health, are most apt to arise from chemical impurities:—

1. Mines charged excessively with variable quantities of carbonic acid, carburetted hydrogen, or smoke from gunpowder used in blasting.

2. Chemical manufactories or class-rooms charged with deleterious gases, mercurial vapours, &c. &c. Workmen in chlorine manufactories sometimes fall down suddenly, as if they were shot, when a blast of strong chlorine overpowers them. The most severe convulsions are observed in sal ammoniac manufactories, where the workmen have been exposed to sulphuretted hydrogen gas in less quantities than are sufficient to induce immediate death.

3. Offices, shops, workshops, and other crowded apartments, where the sole or principal source of heat is derived from the products of respiration and the combustion of gas.

4. Bake-houses, in which carbonic acid from the fermenting sponge, air from drains, heat from an under-ground oven, and vitiated products from gas lamps contribute to produce an oppressive and soporific atmosphere, that would prey still more heavily on the constitution were it not for the severity of the exercise which the bakers undergo.

5. Printing-offices, when there is an immoderate use of gas, low

ceilings, and no means of heat except from the gas lamps and products of respiration.

6. Coffee-rooms in hotels, more particularly those commonly termed "The Travellers' Room," when without ventilation, and immoderately supplied with gas.

7. Lodging-houses for the humblest classes.

8. Public kitchens and private kitchens in large establishments, where non-ventilated charcoal fires, bad air from drains, and local draught, though producing much disease, are rendered milder in their effects so long as ample diet does not derange the digestive functions.

9. Store-houses of volatile ingredients.

10. Grave-diggers, scavengers, and persons employed in cleaning drains, more especially when first engaged in such work, and before the constitution has, to a certain extent, been acclimated to it.

In looking to the jurisdiction exercised by local authorities, there is certainly much reason for believing, however imperfect the state of sewerage, drainage, and cleansing may be in individual towns, that the enormous extent of the evils from such causes has been intimately connected with, if not principally dependent on, a general want of a precise knowledge of their nature and magnitude, and the hopelessness, in general, among the few who had particularly attended to them, of the possibility of any substantial measure of relief. Many difficulties appeared inseparably attendant on the measures themselves, passing over those arising from the supposed impossibility of obtaining the funds necessary for their execution. With such impressions, a fluctuating Board, and no accurate knowledge of those extended schemes that have been of late years gaining ground, as new views have been realized by improvements bearing on every department of general sanatory measures, there must have been, for a long period, little to stimulate hope or to encourage activity to that extent that may now be reasonably anticipated when a clear and connected view is attained, both of the measures themselves and of the means by which they may be carried into execution.

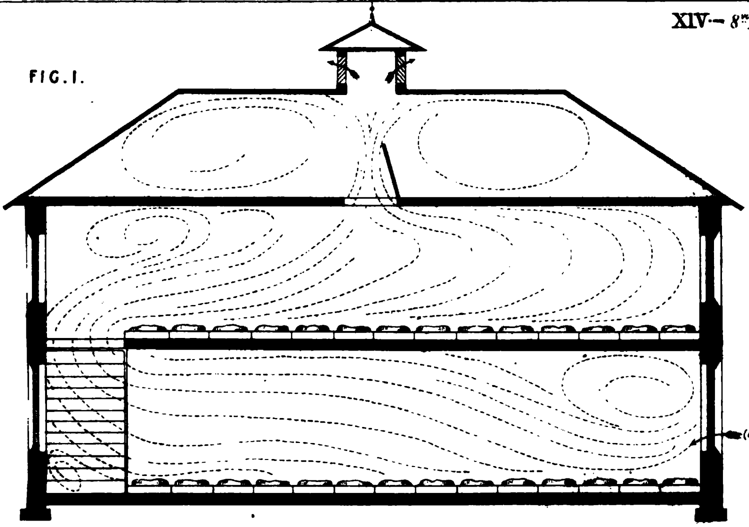
However great the deficiency of sanatory regulations may be in the northern districts, I am desirous of stating here, that, on the whole, I do not consider the defects observed greater than I have witnessed in London and other places. Were I to point out any circumstance more especially severe in its operation, I would refer to those cases where large accumulations of refuse are permitted within close courts, and still more to those where one or more rooms in individual houses are appropriated to this purpose, or rendered useless from the amount of impurities that percolate into them.

It is with great satisfaction, however, that I am enabled to record here the universal interest taken in the objects of the Commission in the different places visited in the northern district. I should not do justice to the impression made upon me, did I not express, in the strongest terms, the perfect cordiality that was universally manifested in promoting the inquiries carried on in the individual towns, and the zeal with which the various subjects were investigated by the subcommittees, though differences of opinion, as might have been expected, were occasionally met with in entering on details, and as to the most suitable mode of obtaining satisfactory information. I have certainly very seldom seen any object in which so many persons, of all denominations, of all stations in society, and professing such diversity of opinions on other matters, concurred so heartily, approving of the object for which they had met, while they uniformly regarded it as a great public cause, the investigation of which was essential to the health and comfort of all classes of society.

It appears now to be generally considered by the inhabitants that remedies of a larger, of a more comprehensive, and of more systematic character than had hitherto been introduced, are essential for any effectual measures of relief, and they did not hesitate to mention that the opinion of neutral persons would generally be desirable on many leading questions bearing on drainage, sewerage, and the supply of water, where local interests come largely into operation; nor were the injurious results unnoticed which arose in different places from a too limited jurisdiction, and from defects connected with the constitution of the present Local Board, or the powers vested in them.

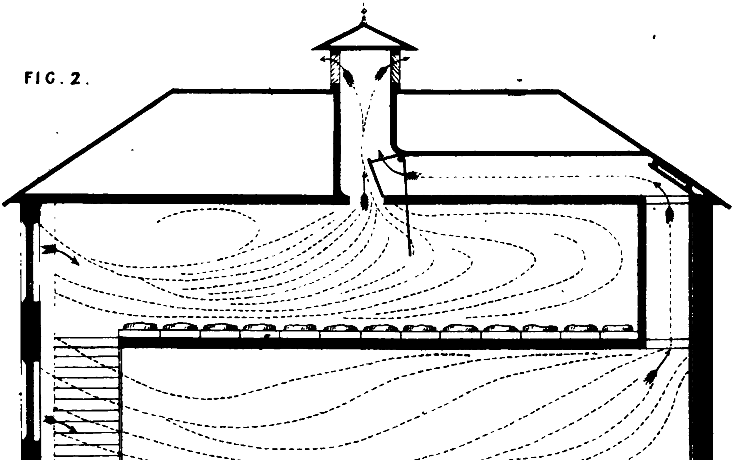
In concluding these remarks, it is highly gratifying to me to be enabled to record, that in every place visited an active spirit of improvement was manifested, and a great desire to search and inquire into the practicability of remedial measures for the deeply-rooted evils that were found to be so universally prevalent. Many of the inquiries made in each district had unfolded scenes which often were far from being generally known in the district in which they occurred; and the evidence printed in London, as well as the queries and suggestions issued by the Commission, have already developed numerous minor improvements, and many proposals for local measures, the mere investigation of which, and the attention thereby given to the means of improving health, cannot fail to be attended with the happiest results, though large and comprehensive combinations can only be expected when new legislative enactments shall have given those resources, which there is too much difficulty in obtaining at present to admit of their being generally appreciated or applied.

FIG. 1.



Longitudinal Section shewing the sleeping berths in one of the Night Refuges for the Houseless poor. In the case exemplified a strong current of cold air entering at (a) fell with great severity upon the berths nearest it while those in the upper floor respired the vitiated products evolved by the respiration of those below. The ventilation was greatly impaired by the ingress of cold air through the roof which diluted and cooled the ascending current of vitiated air.

FIG. 2.



Longitudinal Section of the same apartment shewing a simple arrangement for breaking the force of the current and dividing the supply between the two floors, the ingress to, and discharge from each being proportional to the openings adjusted by their respective valves. Ventilation works with much more power and uniformity when the conflicting influence of cold currents in the roof is excluded by an independent discharging canal as indicated.

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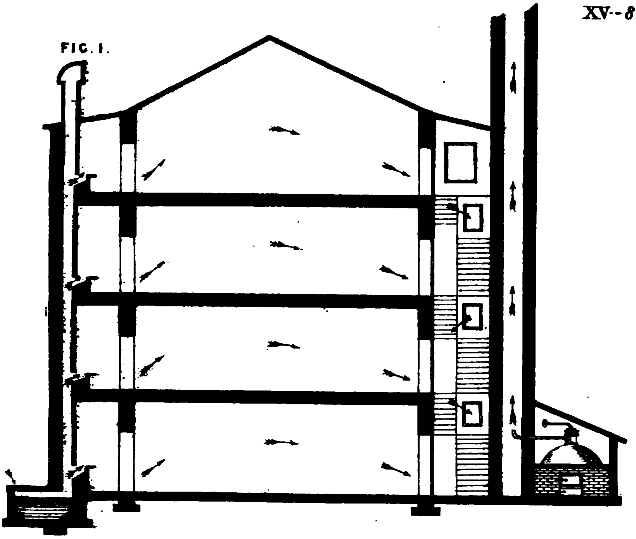
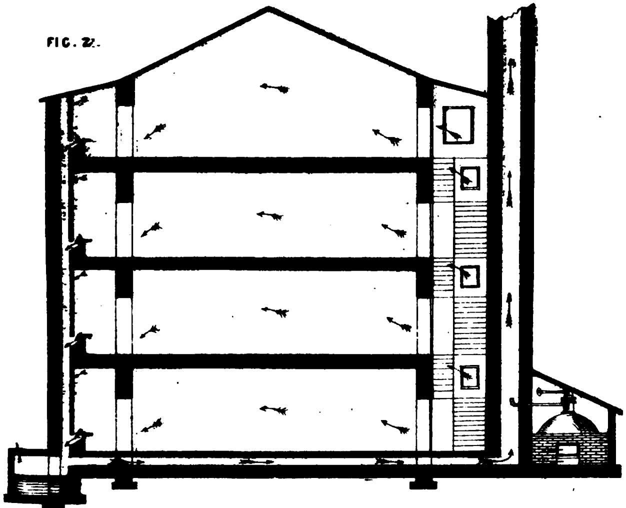
FIG. 1.



Section illustrating a manufactory where a strong ascending current of vitiated air from a cesspool, connected with closets in all the floors, rendered the condition of the atmosphere extremely offensive.

FIG. 2.



Section illustrating the same factory with an underground flue connecting the cesspool with the engine shaft so as to reverse the currents that formerly prevailed fresh air being upplied by the windows in the staircase, passing through the different floors descending the closets as indicated by the arrows and ultimately discharged by the Shaft.

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REPORT

ON

THE STATE OF LANCASTER.

By RICHARD OWEN, Esq.

ONE OF THE COMMISSIONERS APPOINTED BY HER MAJESTY FOR INQUIRING INTO THE
STATE OF LARGE TOWNS AND POPULOUS DISTRICTS IN ENGLAND AND WALES.

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REPORT *on the* SANATORY CONDITION *of* LANCASTER.

BY RICHARD OWEN, ESQ.

"LANCASTER is pleasantly situated on the south bank of the river Lune;" "the town, being built on rising ground, is remarkable for cleanliness; this, and its proximity to the coast, render its air pure and salubrious, and there is a plentiful supply of good water from the springs."* The sanatory condition of such a town might be expected to be on a par with the best that has been hitherto determined on the basis of accurate registration.

The following Tables, which have been carefully prepared for the present Report by Mr. Grant, Superintendent Registrar of the District, demonstrate an average age at death below that which might have been anticipated from the great natural advantages of the town, where such low average appears not to have been suspected, or to have attracted little attention.

The term "town," used in this and the other Tables, comprises the townships of Lancaster and Skirton (the gaol and lunatic asylum being excluded), and has an area of 2260 acres. The population of Skirton numbers 1665, and with the exception of a small proportion, which is agricultural, is similar to the population of Lancaster.

TABLE I.

POPULATION. Town . . . . 14,571 Suburban and Rural 18,876 33,447	Average Age at Death of all who have died.			Average Age at Death of all who have died above 21 Years.		
	Town.	Suburb and Rural.	Total.	Town.	Suburb and Rural.	Total.
Gentry, Professional Persons, and Families	50·26	49·59	49·94	61·3	65·25	63·07
Tradesmen and their Families .	30·22	33·63	31·38	52·01	56·06	53·49
Farmers ditto ditto . .	51·66	46·39	46·71	70·36	65·25	65·57
Artisans ditto ditto . .	26·04	30·84	27·28	53·24	54·55	53·62
Agricultural Labourers and Families	33·05	32·61	32·77	52·81	55·74	55·58
General Labourers ditto .	23·01	24·87	23·37	55·64	54·92	55·49
Factory Hands ditto .	15·34	13·77	14·8	39·67	43·12	40·65
Weavers—Hand-loom ditto .	..	29·57	29·57	..	57·1	57·1
Wool-combers ditto .	..	16·14	16·14	..	39·12	39·12
Fishermen ditto .	..	25·01	25·01	..	52·05	52·05
Paupers in Workhouse . . .	40·18	49·28	43·38	60·29	68·95	63·51
Averages and Totals . . .	27·87	35·04	31·89	54·44	58·95	57·15

---

* "An Historical and Descriptive Account of the Town of Lancaster," 8vo. 1807, p. 60. The spring water is hard. The cleanly aspect of the town is heightened by the effect of the white and variegated sandstone of which the houses of the principal streets are mostly built.

TABLE I.—*continued.*

POPULATION. Town . . . . 14,571 Suburban and Rural 18,876 33,447	Proportion per Cent. of Deaths from Epidemics.			Number of Deaths upon which the calculations are mad		
	Town.	Suburb and Rural.	Total.	Town.	Suburb and Rural.	Tot
Gentry, Professional Persons, and Families	5·92	5·04	5·51	135	119	2
Tradesmen and their Families .	13·06	11·79	12·63	375	195	5
Farmers ditto ditto . .	13·89	8·	8·36	36	550	5
Artisans ditto ditto . .	18·21	12·78	16·81	763	266	10
Agricultural Labourers and Families	11·11	11·79	11·74	36	687	7
General Labourers ditto .	20·	13·87	18·78	571	137	7
Factory Hands ditto .	20·54	22·6	21·25	219	115	3
Weavers—Hand-loom ditto .	..	19·05	19·05	..	21	
Wool-combers ditto .	..	23·07	23·07	..	78	
Fishermen ditto .	..	18·29	18·29	..	82	
Paupers in Workhouse	13·12	4·59	10·12	160	87	2
Averages and Totals . . .	16·77	11·72	14·22	2,295	2,337	4,6

NOTE.—The calculations in this and the following Tables (Nos. 4 and 8 excepted) founded upon the deaths which have occurred in the Town during the six years end June, 1844; and in the suburban and rural parts of the district, during the seven ye ending June, 1844.

It appears from the present Table that the factory hands in Lancaster die, on the average, at the age of fifteen years; the general labourers at twenty-three years; the artisans at twenty-six years; and the tradesmen at thirty-years. The per centage of deaths from epidemics is also sufficiently significant of the influences which in Lancaster abridge the term of life, especially in the labouring population.

The following Table demonstrates the excess of the mortality above exhibited, over that experienced among a class exclusively composed of persons in comfortable circumstances.

TABLE II.

POPULATION. Town . . . . 14,571 Suburban & Rural 18,876 33,447	Average premature Loss of Life as compared with the standard of Mortality, actually attained by the Society of Friends, of all who have Died.			Average premature Loss of Life, as compared with the standard of Mortality, actually attained by the Society of Friends, above 21 Years.			Proportion per Cent. of Deaths under 21 Years, to Total Deaths.		
	Town.	Suburb and Rural.	Total.	Town.	Suburb and Rural.	Total.	Town.	Suburb and Rural.	Total.
Gentry, Professional Persons, and their Families . . .	·25	·95	·57	·92	..	..	20·	26·05	22·38
Tradesmen	20·29	16·88	19·13	10·21	6·16	8·73	46·13	44·1	45·43
Farmers	..	4·12	3·80	..	..	..	30·55	31·27	31·22
Artisans	24·47	19·67	23·23	8·98	7·67	8·60	54·65	44·	52·86
Agricultural Labourers . .	17·46	17·90	17·74	9·41	6·48	6·64	41·66	46·57	46·19
General Labourers . . .	27·50	25·64	27·14	6·58	7·30	6·73	62·68	59·12	62·
Factory Hands	35·17	36·74	35·71	22·55	19·10	21·57	66·66	73·91	69·46
Hand-loom Weavers . . .	..	20·94	20·94	..	5·12	5·12	..	52·38	52·38
Wool-combers	..	34·37	34·37	..	23·10	23·10	..	67·94	67·94
Fishermen	..	25·50	25·50	..	10·17	10·17	..	56·1	56·1
Paupers in the Workhouse .	10·33	1·23	7·13	1·93	..	..	35·62	29·88	33·6
Totals	22·64	15·47	18·62	7·78	3·27	5·07	52·46	44·45	48·42

The following Table exhibits in a striking manner the rates of tality, as proved by the mean age at death, that prevail amon different classes of the population distinguished as town and rural small number of deaths on which the age at death of the gei calculated, gives a less certain result as compared with the classes.

TABLE III.

	Lancaster Town.	Lancaster Rural.	Warton.	Caton.	Wray.	Heaton.	Ark-holme.	Ell
	Average Age of Total Deaths.							
Gentry . .	50·26	62·77	41·5	35·53	58·92	54·68	64·66	45·
Tradesmen & Farmers .	32·1	43·05	44·08	46·05	47·99	29·59	42·62	42·
Operatives .	25·15	29·45	33·44	33·76	32·08	24·05	35·48	26·
Totals .	27·87	35·44	37·37	37·27	40·97	28·22	40·52	30·
	Average Age of Deaths above 21 Years.							
Gentry . .	61·3	68·	63·35	56·	66·09	58·7	64·66	51·
Tradesmen & Farmers .	53·88	58·98	63·36	64·48	64·68	61·45	65·51	64·
Operatives .	53·55	53·75	55·46	61·9	54·85	54·76	60·43	51·
Totals .	54·44	56·85	58·83	62·28	61·37	50·97	63·74	55·
	Proportion per Cent. of Deaths from Epidemics.							
Gentry . .	5·92	7·7	9·3	11·76	..	..	..	.
Tradesmen & Farmers .	13·13	4·59	8·8	8·04	7·61	17·39	5·08	11·
Operatives .	18·44	11·76	14·05	7·61	12·84	14·77	2·56	17·
Totals .	16·77	9·25	12·07	10·06	9·69	14·14	3·96	16·

NOTE.—The Average Age at Death in the Caton District, exclusive of the inmates, is, Total Deaths, 2·93; above 21 Years; 59·02.

The population of each of the above Districts may be obtained Table IV.

In Table III., Lancaster Rural comprises the townships of Ald Halton-with-Aughton, Ashton-with-Stodday, Scotforth, Bulk, with-Hest, and Hest, and has an area of 11,200 acres. The popu is almost wholly agricultural. Out of the 115 deaths of factory mentioned in Table I., 15 belong to this district.

Warton comprises the townships of Warton-with-Lindeth, Ye Redmayne, Yealand Conyers, Dalton, Borwick, Priest-Hutton, forth, Silverdale, Bolton-by-the-Sands, Over Kellet, and Nether K It embraces an area of 19,120 acres, and its population is princ agricultural. The hand-loom weavers referred to in Table I. belo this district.

TABLE IV.

Registrars' Districts.	Population.	Number of Births in Seven Years.	Number of Deaths in Seven Years.	Proportion per Cent. per Annum of Births on the Population.	Proportion per Cent. per Annum of Deaths on the Population.	Proportion per Cent. of Bastards born to Total Births.
ancaster, Town	14,571	3,302	2,669	3·24 or 1 in 30·89	2·62 or 1 in 38·21	8·055
ancaster, Suburban and Rural	2,060	378	270	2·62 or 1 in 38·15	1·87 or 1 in 53·41	8·677
arton	3,780	704	497	2·66 ,, 37·58	1·88 ,, 53·24	10·937
aton	1,964	487	328	3·54 ,, 28·23	2·38 ,, 41·91	6·753
ray	2,309	485	227	3· ,, 33·33	1·40 ,, 71·20	7·01
eaton	2,468	552	297	3·15 ,, 31·31	1·72 ,, 58·16	5·435
rkholme	1,017	119	101	2·79 ,, 35·07	1·42 ,, 70·49	11·055
llel	4,452	1,081	529	3·47 ,, 28·83	1·69 ,, 58·91	6·011
unstall	826	172	88	2·97 ,, 33·62	1·52 ,, 65·71	11·046
Totals of Rural Districts	18,876	4,058	2,337	3·07 or 1 in 32·56	1·77 or 1 in 56·54	7·663
Totals of Town and Rural Districts.	33,447	7,360	5,006	3·14 or 1 in 31·81	2·14 or 1 in 46·77	7·840

NOTE.—The proportion per cent. per annum of Births in the Caton District, exclusive of the Workhouse nmates, is 3·35, or 1 in 29·84; and the Deaths 1·83, or 1 in 53·56.

Caton comprises Caton, Claughton, and Quernmore; has an area of 16,150 acres, and a population partly manufacturing and partly agricultural. Forty-two out of the 115 deaths of factory hands alluded to above, occurred in this district.

Wray comprises the townships of Wray-with-Bolton, Melling-with-Wrayton, Hornby, Wennington, Roberindale, Forleton, and Tatham, and has an area of 24,790 acres. A little manufacturing is carried on at Wray, but the population of the district is principally agricultural. Out of the 115 deaths of factory hands above alluded to, 17 have occurred in this district.

Heaton comprises the townships of Heaton-with-Oxcliffe, Heysham, Middleton, Poulton-Bore-and-Townsholme, and Overton, and has an area of 6930 acres. The fishermen alluded to in Table I., with the exception of a few in the Warton District, belong to this district, otherwise the population is agricultural.

Arkholme comprises the townships of Arkholme and Cawood, Whittinton, Docker, and Gressingham, having an area of 9120 acres, with a population agricultural.

Ellel comprises the townships of Ellel, Over Wyersdale, Thurnham, and Cockerham, and embraces an area of 29,130 acres. The woolcombers mentioned in Table I. belong to this district, and 41 out of the 115 deaths of factory hands mentioned in the said Table, also belong to this district. The population is partly manufacturing and partly agricultural.

Tunstall comprises the townships of Tunstall, Lock, Ireby, Caulsfield, and Burrow-with-Burrow; has an area of 10,780 acres, and an agricultural population.

Tables V., VI., VII., are formed from deaths which have occurred in the Lancaster Town District during the six years ending June 1844. In order to bring the facts involved in the above numbers more forcibly to the mind, through the eye, three diagrams, showing the periodic diminution of the sum of vitality, from birth to the latest term of existence, in the respective classes of gentry, tradesmen, and operatives, accompany these tables. The curves are formed from the registers of deaths in the six years ending the 30th of June, 1844.

TABLE V.

PERIODS OF DEATH. From Birth.	GENTRY.			TRADESMEN.		
	Deaths per Cent. between each Period.	Total Deaths per Cent. at the end of each Period.	Remaining at the end of each Period per Cent.	Deaths per Cent. between each Period.	Total Deaths per Cent. at the end of each Period.	Remaining at the end of each Period per Cent.
At 6 months	6·62	6·62	93·38	11·594	11·594	88·406
,, 1 year	2·2	8·82	91·18	3·381	14·975	85·025
,, 2 years	1·47	10·29	89·71	5·797	20·772	79·228
,, 5 ,,	2·2	12·49	87·51	9·42	30·192	69·808
,, 10 ,,	2·2	14·69	85·31	5·797	35·989	64·011
,, 20 ,,	6·62	21·31	78·69	7·246	43·235	56·765
,, 30 ,,	6·62	27·93	72·07	7·488	50·723	49·277
,, 40 ,,	5·148	33·08	66·92	7·488	58·211	41·789
,, 50 ,,	11·04	44·12	55·88	10·387	68·598	31·402
,, 60 ,,	10·295	54·41	45·59	8·213	76·811	23·189
,, 70 ,,	10·295	64·71	35·29	9·179	85·99	14·01
,, 80 ,,	19·852	84·56	15·44	9·179	95·17	4·83
,, 90 ,,	13·97	98·53	1·47	4·348	99·517	·483
,, 100 ,,	1·47	100·	··	·483	100·	··
	Terminates at 95 years.			Terminates at 93 years.		
	OPERATIVES.			THE THREE CLASSES.		
At 6 months	15·341	15·341	84·659	14·149	14·149	85·851
,, 1 year	8·301	23·642	76·358	7·052	21·201	78·799
,, 2 years	8·472	32·114	67·886	7·575	28·776	71·224
,, 5 ,,	11·849	43·963	56·037	10·84	39·616	60·384
,, 10 ,,	5·724	49·687	50·313	5·529	45·145	54·855
,, 20 ,,	6·526	56·213	43·787	6·661	51·806	48·194
,, 30 ,,	7·442	63·655	36·345	7·4	59·206	40·794
,, 40 ,,	6·64	70·295	29·705	6·71	65·916	34·084
,, 50 ,,	5·201	75·496	24·504	6·486	72·402	27·598
,, 60 ,,	5·782	81·278	18·722	6·487	78·889	21·111
,, 70 ,,	6·928	88·206	11·794	7·532	86·421	13·579
,, 80 ,,	7·9	96·106	3·894	8·834	95·255	4·745
,, 90 ,,	3·32	99·426	·574	4·136	99·391	·609
,, 100 ,,	·516	99·942	·058	·566	99·957	·043
	Terminates at 100 years.			Terminates at 100 years.		

In Table V. it will be seen, that in the third class of inhabitants, the stream of life has been deprived of half its volume when it has run through only one-tenth part of its course; and although the difference which the first class manifests in this respect is in part explicable on

the greater care bestowed by the rich upon their offspring, yet it is too extreme not to lead to inquiry into the more general causes, connected with the state of the dwellings of the labouring classes, which may operate in producing the excessive infantile mortality thus indicated.

TABLE VI.

s of Age. — 21 Years old.	GENTRY.			TRADESMEN.			OPERATIVES.		
	Deaths per Cent. between each Period.	Total Deaths per Cent. at the end of each Period.	Remaining at the end of each Period per Cent.	Deaths per Cent. between each Period.	Total Deaths per Cent. at the end of each Period.	Remaining at the end of each Period per Cent.	Deaths per Cent. between each Period.	Total Deaths per Cent. at the end of each Period.	Remaining at the end of each Period per Cent.
30 years	8·411	8·411	91·589	10·917	10·917	89·083	15·334	15·334	84·666
40 ,,	6·542	14·953	85·047	13·537	24·454	75·546	15·467	30·801	69·199
50 ,,	14·02	28·973	71·027	18·777	43·231	86·769	12·133	42·934	57·066
60 ,,	13·084	44·057	57·943	14·847	58·078	41·922	13·467	56·401	43·599
70 ,,	13·084	55·141	44·859	16·594	74·672	25·328	16·133	72·534	27·466
80 ,,	25·233	80·374	19·626	16·594	91·266	8·734	18·40	90·934	9·066
90 ,,	17·757	98·131	1·869	7·86	99·126	·874	7·733	98·667	1·333
00 ,,	1·869	100·	··	·874	100·	··	1·2	99·867	·133
	Terminates at 95 years.			Terminates at 93 years.			Terminates at 100 years.		

TABLE VII.

ods of Age. — n 30 Years old.	GENTRY.			TRADESMEN.			OPERATIVES.		
	Deaths per Cent. between each Period.	Total Deaths per Cent. at the end of each Period.	Remaining at the end of each Period per Cent.	Deaths per Cent. between each Period.	Total Deaths per Cent. at the end of each Period.	Remaining at the end of each Period per Cent.	Deaths per Cent. between each Period.	Total Deaths per Cent. at the end of each Period.	Remaining at the end of each Period per Cent.
40 years	7·148	7·148	92·852	15·197	15·197	84·803	18·268	18·268	81·732
50 ,,	15·303	22·451	77·549	21·079	36·276	63·724	14·330	32·598	67·402
60 ,,	14·285	36·736	63·264	16·666	52·942	47·058	15·905	48·503	51·497
70 ,,	14·285	51·021	48·979	18·627	71·569	28·431	19·056	67·559	32·441
80 ,,	27·551	78·572	21·428	18·627	90·196	9·804	21·733	89·292	10·708
90 ,,	19·387	97·959	2·041	8·823	99·019	·981	9·134	98·426	1·574
100 ,,	2·041	100·	··	·981	100·	··	1·417	99·843	·157
	Terminates at 95 years.			Terminates at 93 years.			Terminates at 100 years.		

Table IX. will convey some idea of part of the expense entailed upon a town during the continuance of those causes which tend to undermind the health and abridge the life of the labourer and artisan, and which may be removed by improved sanatory, and therefore more economical, regulations.

Mr. Grant, the able Superintendent Registrar, to whom I am indebted for the foregoing and following tables, informs me that the Lancaster Poor Law Union, and the Superintendent Registrar's district of Lancaster, are not, as usual in other places, co-extensive; and that Table IX. has reference to the Lancaster Union only, comprising 19 townships, with a population of 23,943: it is also formed from cases of widows and orphans *resident* in the Lancaster Union, without any reference to their place of settlement, and it includes such only.

TABLE VIII.

Different RATES of MORTALITY prevalent during SEVEN YEARS, among several Classes of MALE OPERATIVES above 21 Years of Age, in the Town of LANCASTER.

TRADES.	Number of Deaths.	Average Age at Death.	Number of Deaths from Epidemics.	Proportion per Cent. of Deaths from Epidemics to Total Deaths.
IN-DOOR.				
Tailors	16	45·06	1	6·25
Shoemakers	23	58·91	3	13·04
Joiners and Wheelwrights	17	54·23	1	5·88
Cabinet-makers	16	51·68	..	..
Black and White Smiths	15	44·13	..	..
Factory Hands	31	37·26	3	9·67
Miscellaneous	56	49·73	2	3·63
Totals	174	48·43	10	5·74
OUT-DOOR.				
Stone Masons	29	39·79	3	10·34
Stone Quarrymen	7	53·85	..	..
Agricultural Labourers	11	62·72	1	9·09
General Labourers, chiefly employed out-door	70	58·92	7	10·
Seamen	18	62·55	..	..
Miscellaneous Out-door Workmen.	57	54·52	..	..
Totals	192	55·1	11	5·72
In and Out-door Totals	366	51·9	21	5·73

Although the low average age of death in the classes of tradesmen, artisans, and labourers, appears not to have attracted due attention, the proneness to the development of epidemics, especially of more or less malignant forms of fever, in the town of Lancaster, has been long recognised, and has led to charitable institutions for the reception, relief, and insulation of such cases of disease.

I received concurrent testimony from several medical practitioners of the town, that such fevers were seldom absent from certain localities, to be specified hereafter: and they have occasionally spread and prevailed to an alarming degree, and have been the subject of special description.

Dr. Campbell, a highly esteemed physician, who practised his profession during more than half a century in Lancaster, thus notices, in a pamphlet published in 1785, one of those typhoid epidemics which ravaged the town in the years 1782 and 1783:—

"A fever of the particular species, which is mentioned in the foregoing chapters, was epidemic at Carlisle, in the year 1781;* but I did not see any person affected with it at Lancaster until the summer of 1782.

---

* Heysham on the Jail Fever.

Whether it was originally produced here, or imported from a distance, I was unable to ascertain; the houses in which it first appeared being equally favourable for either supposition. From that period to the present, it has continued to rage with more or less frequency and fatality. It has, with few exceptions, been confined to the poor and labouring classes of people: but when persons in better life were attacked, the symptoms were not less severe than with others. The seasons or weather seemed to have little influence either in extending or retarding its progress: sometimes we had many persons labouring under the disease; at other times, it would almost totally disappear, and then break out again, generally in families, whose intercourse with others who had been sick afforded a ready conveyance for contagion.

TABLE IX.—LANCASTER UNION.

WIDOWS.			£.	s.	d.	
Total Number of Widows at present chargeable, on account of widowhood, whose Husbands, had they been living, would now have been under 60 years of age	91	..	. .			..
Total Number of Children under 16 years of age, dependent upon them	241	..	. .			..
Average Period of Chargeability actually experienced by them	..	5·1	. .			..
Annual Cost	..	..	650	0	0	..
Cost per Cent., in proportion to the Annual Total Cost of Paupers	..	..	. .			13·88
Average Age at death of the Husbands of the above widows	..	38·55	. .			..
Total Number of Widows at present chargeable, whose Husbands, had they been now living, would have been 60 years of age, and upwards	104	..	. .			..
Average Period of Chargeability actually experienced by them	..	7·02	. .			..
Annual Cost, including their 14 Children	..	..	468	0	0	..
Cost per Cent., in proportion to the Annual Total Cost of Paupers	..	..	. .			10·
Average Age at death of the Husbands of these Widows	..	62·65	. .			..
ORPHANS.						
Total Number of Children under 16 years of age, both of whose Parents are dead; the Fathers, had they been now living, would have been under 60 years of age	55	..	. .			..
Average period of Chargeability actually experienced by them	..	2·51	. .			..
Annual Cost	..	..	234	0	0	..
Cost per Cent., in proportion to the Annual Cost of Paupers	..	..	. .			5·0
Average Age at death of the Fathers of these Children	..	38·51	. .			..
Total Cost of Widows and Orphans	..	..	1,352	0	0	..
Total Cost per Cent. of Widows and Orphans, in proportion to the Annual Total Cost of Paupers	..	..	. .			28·88

The number of persons in this complaint who have fallen under my observation in Lancaster is about 500, of whom 34 died: which is, upon an average, rather more than 1 in 15. Of these 168 were men, whereof have died 20, which is nearly 1 in 8: 236 were women, whereof have died 11, which is about 1 in 22."

The continuation of similar cases of typhoid fever led to the establishment, in the present century, of a "House of Recovery," which has since merged into a fever-ward in the Infirmary near Dalton-square.

The principal conditions of a town, which counteract the most favourable natural advantages, and engender typhoid and other maladies, increasing the rate of mortality, are now generally admitted to be the retention of decaying animal and vegetable refuse in and near the inhabited dwellings. Attention was, therefore, chiefly directed to this point; first, as it depended upon the state of the sewerage and drainage of the town; and next, on the quantity, quality, and mode of supply of water. And having obtained from the observations and inquiries thereupon instituted, together with the instances of insufficient ventilation and overcrowding of such abodes, sufficient explanation of the causes of the state of mortality demonstrated by the foregoing tables, and of other evils deeply affecting the welfare of the poorer inhabitants of Lancaster, I shall confine this Report chiefly to these subjects.

Sewerage and Drainage.—The Surveyor of Sewers and Pavements of Lancaster had no plan of the sewerage of the town. From him I learnt that most of the streets had soughs or sewers; that, with the exception of one street, in which the section of the sough was oval, the rest were square; and that he continued to make them of the old square form. Edmund Sharpe, Esq., M.A., county architect and surveyor, has since supplied me with a plan of the present sewerage of the town, and states, in the letter accompanying that plan,—"The drains are square and flat-bottomed; the sides are built of loose rubble-walling, laid in common mortar; no pains are taken to make the joints good; no cement or hydraulic lime is used; and, were it not for the rapid fall of most of the streets, the sewerage would never leave the rough sides and bottoms of the drains. As it is, the stench is frequently intolerable, and the complaints incessant.

"I send you the cost of the present ill-constructed drains, as well as that of the excellent circular tile drains, from which you will see that the increase in cost is only one-fourth more for the large size, and nothing in the smaller sizes."*

The sewers serve to carry off the surface moisture, which is received

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* *Old Sewerage.—Cost:—*			s.	d.
	Main drain	per lineal yard	6	0
	Branch-street drain	ditto	4	6
	Drains from yards, &c.,	ditto	2	0

The two first are made of flag or slate bottom, rubble stone sides, and rough stone covers. The small yard drains are often made without bottoms. The main is generally 2 feet 6 inches × 1 foot 4 inches. Middle size, 1 foot to 16 inches square; and the smaller ones, 6 inches or 7 inches square.

Estimate of New Sewerage:—Tile pipes, socket joints, with elbows, &c., complete.

			s.	d.		£.	s.	d.
4,817	lineal yards, main,	at	7	6	. . . .	1806	7	6
3,870	ditto secondary,	at	4	6	. . . .	870	15	0
11,330	ditto branches,	at	2	3	. . . .	1274	12	0

by untrapped gratings or gully-holes, together with so much of the surface filth and refuse as is not removed by scavenging. The house-drains serve principally to carry off the waste water: but with regard to the combination of house and street drainage, the information which I was able to obtain was vague and uncertain. I have reason to believe that the instances are limited to a few amongst the better class of houses in which a supply of water has been provided and applied to carry off the most offensive refuse from their interior. But the quantity of offensive decomposing animal and vegetable substances which finds its way into the sewers has much increased of late years.

The entire contents of the sewers of the town of Lancaster, with the exception of that in Bridge-lane, are ultimately delivered into an ancient mill-stream. This begins at Dalton dam, a diverticulum of the river Lune, and, after a course of 1400 yards, terminates in the river at the lower part of the town, near the Old Bridge. About 700 yards of this receptacle of the town-sewage flows through the lower part of the town. Through the greater part of its course the current of the mill-race is very sluggish, and at high tide it is reversed, its contents being driven back towards its commencement, at the dam. By this flux and reflux the decomposing matters received into it are mixed together and agitated, their decomposition accelerated, and the escape of the miasmatic and noxious effluvia and gases promoted. The progressive growth of the town and consequent increase of the offensiveness of the mill-race, which may be compared to a prolonged cesspool, have led to its being arched over, along a great proportion of that half of its course which extends through the inhabited part of the town. The portion of the mill-race which was undergoing this expensive modification during the period of my inspection was about 72 yards in extent, and flowed through a garden extending from the residence of the proprietor, in Leonard-gate, to the Green-area. The contract price of the work was 100*l.*; but the gentleman (Mr. George Burrow) who had gone to this expense to abate the nuisance, informed me that it would cost him more money before it could be satisfactorily completed. This fact yields an approximate estimate of the expense which has been incurred in bridging over about 600 yards of the intramural portion of the mill-race; an operation which conceals, without materially abating, the evil of that sluggish receptacle of the town sewage.

Many of the wells in the vicinity of this part of the mill-race have

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1,700 lineal yards, main outlet, at 9*s.*	£765	0	0
320 gulleys, with stench traps and pipe complete, at 17*s.* 6*d.* each	292	10	0
	£5009	4	6

30,000*l.* worth of rateable house property, or 3500 houses at a rent of from 5*l.* to 50*l.*, the average being 9*l.* per annum. Say,

850 at from	5*l.* to 7*l.*
850 at about	7*l.*
500 at from	7*l.* to 10*l.*
500 at about	9*l.* to 10*l.*
300 at from	10*l.* to 12*l.*
300 at from	13*l.* to 20*l.*
200 at from	20*l.* to 50*l.*
3500	

Sewer Rate.

	£.	*s.*	*d.*
4 per cent. on 5000*l.*	200	0	0
Annual expenses	150	0	0
	£350	0	0

30,000 at 2¾*d.* in the pound, 347*l.* 16*s.*

been polluted by the soaking of its contents into the soil. It affects the cellars and foundations of the adjoining houses, and is probably a chief cause of the occurrence of typhus fever in its vicinity, as in Damside-street, and parts of St. Leonard-gate. At the present time the mill-race performs no other office than to intercept the currents of the main sewers (the contents of which ought to be speedily delivered at a distance from the mass of the population), and to form the medium of their gradual escape, subject to the alternations of the tidal current, into the river. The mill, for the working of which the dam and race were originally made, has long ceased to exist; its place is shown in Speed's plan of the town, as it stood in 1610. There are no rights to be purchased: they were originally leased to the family of Dalton for 200 years; and were rendered up at the expiration of the lease, by a representative of the family, to the Municipal Corporation.

Besides the influence of the defective structural arrangements of the present system of sewage in exciting febrile epidemics and producing the excess of mortality of the tradesmen and operatives of Lancaster below the average of a healthy town; another cause, which operates, especially in the districts inhabited by the poorer classes, arises out of the inapplicability of the present system of sewerage to the speedy removal from such districts of the most offensive and noxious refuse. The sewers and drains are unconnected with any special water-supply or power of scouring or flushing them, and in fact, as in most other towns, they are not at present so constructed as to admit of that essential condition to their complete operation in a sanatory point of view. The instances, as before stated, are extremely rare, in which a supply of water has been provided and applied to the purpose of carrying off the excreta from the interior of the houses, and in these cases the drain usually terminates in an adjoining cesspool. The domestic refuse is thrown into the midden-stead or bog-holes, which are generally open receptacles attached to privies, and form, in the more or less close contiguity of every house in the town, a mass of decomposing and putrescent animal and vegetable matter. These centres of atmospheric pollution are carted away at intervals of time, usually regulated by the capacity of the receptacle; the periods varying from three months to three years or more. I was informed of some severe cases of typhus fever which had occurred in wealthy families, and had originated so soon after the emptying of such receptacles as to lead the medical attendant to infer a close connexion between that operation and the outbreak of the epidemic.

In the better class of houses, however, the offensive accumulations are usually placed far enough from the doors and windows to prevent immediate annoyance, and their more insidious and constantly deteriorating influences do not excite attention.

But it is in the parts of the town which are densely populated by the poorer classes, where the proportion of the most noxious constituents of the decomposing mass is increased, the proximity of the whole to the habitations closer, and the escape of the emanations from the alleys, courts, and yards, more difficult, that the influence of defective means of removing excreta from town dwellings in destroying the comfort, undermining the health, and deteriorating the morals of those exposed to its operation is most manifest.

In my inspection of the poorer districts of the town, I was accompanied by Mr. Charles Ricketts, resident medical officer of the Lancaster Infirmary, and occasionally by Edmund Sharpe, Esq., architect. The following selections from notes taken on the spot, are far from being extreme or exceptional cases of the state of things observed:

Chapel-court, a space about 60 feet in length and 7 feet wide, is enclosed at both ends, as well as at the sides, by houses from 20 to 30 feet high: it is entered by a covered way, about 3 feet wide and 7 feet high. The privy-accumulation or midden-stead was exposed within the court; it contained the usual accumulation of decomposing excrementitious and other matters, the soakings from which filled a stagnant kennel traversing the court, and slowly escaped by an untrapped gully-hole, near the entry, into the adjoining sewer. The noxious emanations from these sources are greatly aggravated by the obstruction to free ventilating currents of air. The court is the occasional seat of febrile and phthisical disorders.

My medical guide conducted me to a court called *Croft's-yard*, where several cases of fever had occurred. We entered it by a covered passage, or tunnel-entry leading from St. Leonard-gate, 1 yard wide and 2 yards high, and about 20 feet in length, opening into a small square court, built up on three sides, and closed on the fourth, opposite the entry, by walls, propping up the soil of a garden above the level of the first floor of the houses. The privy and midden-stead occupied one side of this enclosed space, abutting against the first story; its oozings infecting the walls of the dwelling, and also contributing to the morbific character of the stagnant water which accumulates in wet weather at the bottom of the court, whence it drains off sluggishly by an open kennel to the untrapped grated opening of the sewer at the entry. The removal of the midden heap was described as a grievous aggravation of the habitual noisomeness of the confined atmosphere of this court. It is first thrown out by hand labour upon the floor of the court, then wheeled by barrows full down the narrow passage into the street, whence it is finally carted away. The farmer is willing to give 2*s.* in addition to the labour for this manure. The water for cleansing the court after this laborious and noisome operation is fetched from a public pump at some distance.

In *Brewery-yard*, the common passage to several tenements, communicating with Moor-lane, but no thoroughfare, an open kennel extends down the middle, widening into a large green stagnant pool, at the blind end of the court, where it is partly concealed from view by a low stone wall built across the kennel: at one end of the yard is the usual midden-stead, at the other was a colony of pigs. An underground drain extends from the street drain half-way down this yard; but the slope of the surface carries most of the refuse by the open kennel in the opposite direction to the terminal stagnant pool. This yard is one of the noted localities of fever.

Another equally frequent source of patients for the fever ward, is a neighbouring court called *Plough-yard*, communicating with the opposite side of Moor-lane, by a narrow entry: the yard which leads off at right angles from this entry is everywhere surrounded, except at the indirect passage to the street, by houses from 20 to 30 feet in height. One privy serves all the inhabitants of this yard, besides trespassers from the street. It is situated at the blind end of the yard with an enormous open midden-stead, emitting the usual offensive effluvia. There was a stagnant kennel along the middle of the yard, soaking through the ill-paved surface, and infecting the foundation and ground floors with its noxious damps.

My attention was called by both District Visitors and the Dispensary Medical Officers, to *Oven-house-yard*, China-lane: in the middle were two enormous middens, the oozings from which were accumulated in stagnant pools. An operative builder, who had received an injury from a fall two years before was still slowly recovering. He had been recommended by one of the magistrates to prefer a complaint of this nuisance, but did not like to be a bad neighbour, the landlord of an adjoining public-house claiming a vested interest in the pestiferous accumulation.

The aggravation of the ills of poverty, by the defective arrangements for the removal of excreta was perhaps nowhere more strikingly manifested than in the case of four abodes in *Dye-house-lane;* where, in consequence of the confined space, the privy and ash-heaps were accumulated in the cellars. Commonly, the excuse for closed doors and windows was, the bad smell of the court; but here I found a special contrivance for keeping open the outer door, without which the tenant said, "she could not bide in the house:" "the stench at night was sometimes past bearing, especially in rainy weather." But the rent was low, 1*s.* 9*d.* per week, for three rooms, on account of the nuisance: if they could afford to pay more, they would not stay; but, as one of the tenants said, "need makes one submit." This poor woman was an almost constant patient at the Dispensary for dyspepsia and gastric irritation. The cellar accumulation often overflowed; for "it was such an awkward place, the farmers did not like the trouble of fetching it out," and the landlady had sometimes been induced by the tenants' complaint to pay for its removal.

5 In *Wood-yard* there are three or four surface drains, but they have no communication with the street sewer: the drainings from the middens in the *Boar's Head-yard*, and from some pig-sties, accumulate in the court, and are carried out by buckets into the street, four times a-week. There is here much sickness and infantile mortality: the wife of John Huddersall had managed better than her neighbours, and had reared two out of five children. The privy accumulation was enormous, and sometimes sells for 13*s.*, yielding eight or nine cartloads. The amount paid for soda to soften the pump water for washing, varies from a halfpenny to three half-pence per week, in the different families of the court.

6 A court leading out of *Mason-street*, presents an enclosed quadrangular space, about 20 feet in length, and 7 feet in width; the middle of this space is crossed by two privies and their usual open accumulations; at the sides of the court are houses varying in height from 20 to 30 feet; and each end of the court is blocked up by a house of the same height, the inmates of which houses were seldom off the Dispensary books. The Medical Officer has found the stench of this place so intolerable, as to be compelled to quit his patient as soon as possible.

In another court out of *Mason-street*, about 6 feet wide, and containing two privies, clothes were hanging to dry, and absorbing the fetid atmosphere.

A third court is below the level of the street: the floors of the houses are always damp, and this state is greatly aggravated at high tides, when the old mill-stream receptacle of the town's sewers is forced back up the gully-holes, and floods all the yard. They had a very scanty supply of water: there I heard the common complaint that the pump was down, with the addition of the water being unfit for drinking when raised, the well having become polluted by the surrounding drainings; "it was only fit for slopping, not fit for use." The tenants have to go to a pump about a hundred yards off; with the usual tax for soda, or with the expenditure of much time and labour in getting rain water fit for washing.

The degree of domestic cleanliness, with these evils to contend against, were, notwithstanding, highly creditable to the poor women, the wives of the operatives who tenant these abode. But, too frequently, the effect of the difficulties and constant operation of surrounding annoyances—all within the scope of economical and efficient preventive arrangements—was manifest in the sordid, sickly, and querulous slatterns, into which women of originally cleanly and orderly habits had sunk, with obvious signs of habitual resort to intoxicating stimulants, combining to render the interior of their abodes as intolerable to the husband and the children as the exterior was disgusting.

On one side of Bridge-lane, the houses, in an almost ruinous condition, are piled up against the steep base of the Castle-hill, which there descends suddenly towards the river. At the summit of one of these piles, called the *Forty Steps*, I found a plateau, supporting a range of pig-sties, fronted by an area 3 yards wide, which was one mass of corruption and stench, and stood on a level with the roofs of the houses, fronting the street or lane. The feculent matter blended with the rain and land springs from the hill side, drains down and soaks into the foundations and walls of the houses in its descent. I learnt, without surprise, that the morals of the inhabitants of this locality were as low as their physical comforts.

Lime-street, parallel with the quay, manifests the usual consequences of imperfect drainage and the open privy system. No. 8, a seat of fever, receives the damp drainings through the wall, from a large midden-heap on the other side. Narrow and enclosed courts, with tunnel entries, lead from this street, most of them with the midden and privy heaps in a most pestilential condition.

I received strong testimony, from medical and other sources, of the unhealthiness of a locality inhabited by small tradesmen and operatives, called *Germany road* or *street*, which well exemplified the evils of a bad drainage system. It is in the close vicinity of the old mill stream, which here begins to receive the contents of the sewers; the whole vicinity of that sluggish receptacle of the excreta of the town has always been a noted locality of typhus and other forms of low fever. At the beginning of Germany-street, the houses join back to back with those at the end of Leonard-gate: and here my attention was first offensively arrested by a huge dung-heap in front of the tenement of a cow-keeper. In an adjoining court, the constant privy-heap at the blind end was unusually pestilential; the accumulation of the refuse of many abodes, it requires removal four times a year: the women, who take the task of cleansing after the removal, share the small profits from the farmer's purchase, which amounts to sixpence each.

In *Germany-row*—a closed court, with smaller ones communicating with it—there is an open well, supplying the inhabitants and the surrounding neighbourhood with the usual hard water. The overflowings of the well run to an open kennel in the court, which receives also the drainings of two or three privy midden-steads, and of two pig-sties: this stagnant solution soaks to the foundation and through the floors of the houses, and in rainy weather it rises so as to flow in at the doors: it finds its sluggish way into Germany-street, where it used to be received, with similar contributions from adjoining courts, into an open drain. This, in consequence of the representations to the Sewers Commission, of the frequency of fever, had, within a year previous to my inspection, been converted into a covered drain or sewer. It remains to be seen how far this attempt to diminish disease, by local improvement of drainage, will succeed: its value, at present, seems to be chiefly the admission by the authorities of the connexion between disease and bad drainage.

The open, and here almost stagnant mill-race, extends from Germany-bridge, 700 yards northward; the mud at the bottom was emitting mephitic bubbles. The inhabitants of the houses built on its west bank had supplied the Dispensary with many cases of fever; and the Medical Officer, Mr. Ricketts, observed, that in these and other maladies, when not fatal, the recovery was always slow; they did not rally or regain strength, as they would do in more healthy localities.

Parliament-street is an enclosed court, having one covered or tunnel entry, on the banks of the mill-dam, and a similar outlet into Green Area. Each of these openings is about 3 feet wide, and 7 feet high; they lead to a space of 14 yards long and 6 yards wide, inclosed on every side by good houses, from 24 to 30 feet in height. At one end of this inhabited shaft, or well, at the corner furthest from the covered entry, is the usual privy and midden-stead, rendered by the absence of ventilation more than usually offensive. The mistress of the dwelling next to the privy complained bitterly of the nuisance; her hectic cheeks bespoke the struggle which the constitution was undergoing: she had been very bad that night; had suffered two hours' purging; her husband (James Mackerell) had also suffered: they would leave the house as soon as they could get another. They paid for three rooms 2*s.* 4*d.* a-week. A well and good pump were situated in the middle of the court; and this expensive, but, in Lancaster, common mode had been here adopted to supply the inhabitants of the street with water, not only, as usual, too hard for washing, but unfit, from its offensive brackish taste, for drinking or culinary purposes: it was used only for the coarser operations of scouring the floors, the household utensils, and the yard. The removal of the midden soil, by the usual operations of digging and throwing it out into the court, and wheeling it into the street to be carted away, was referred to with looks and in language sufficiently expressive of its disgusting nature, aggravated, as it must be, by the slow dissipation of the stench in this pent-up locality. There had been fever in almost every one of the well-built houses inclosing Parliament-street, within the experience of the present Dispensary Resident Officer.

In Back Cable-street, the surface drainage was, until lately, in as noxious a state as that described in Germany-court; but, in consequence of the representations of the Dispensary Medical Staff, of the frequent occurrence of fever here, a closed drain was, four months ago, carried along the front of the houses into the adjoining mill-race. The complaint at this street was chiefly of the insufficiency of the single privy for the inmates of the thirty houses for which it had been provided: here, as elswhere, I heard of the trespassers from the street, and of the unwillingness of the younger females to go to the place. Motives of decency and morality combine with those of health and economy in urging upon the serious attention of the local authorities the advantage and importance of a system of sewerage capable of being combined with the in-door soil-pan system, as recommended and explained in the evidence of Messrs. Austin, Hawksley, and Foden.*

In Sugar-house-alley, the surface-drainage continues in as bad a state as in Germany-court; the backs of the houses open upon an enclosed area, along the bottom of which flows the old mill-race. The approach to this area is by a narrow covered passage, on entering which I was met by an indescribable kind of damp, sub-fetid emanation; at the end of the passage was a privy: the midden-heap being partly concealed in a vault or cellar, beneath the ground-floor of the house, perforated by the passage. Emerging thence, I stood upon a steep bank leading from the backs of the houses to the bed of the mill-stream; on the opposite side was a lofty wall, at each end a low arch, through which the black filthy stream was sluggishly flowing. Each arch supported houses, completing the enclosure of the area. The stream was confined to the mid-channel; at the sides it formed stagnant pools, receiving the drainings from ash and midden heaps and the out-castings from the overhanging windows. The fetid solution soaks through the foundations of the houses. When the tide flows, the mill-race, receiving the main sewage of the town, is driven back towards its source, traversing the area in its progress, and again slowly returns at the ebb. Thus the enclosed area, about forty yards in length, is ventilated chiefly by an impure atmosphere, which escapes from beneath the arches at each end at every flux and reflux of the stream. A more typical source of miasmata can scarcely be conceived.

Supply of Water.—An abundant supply of water is essential to an effective system of sewerage. Sewers and drains, it has been well observed, furnish merely the ways and vehicles for the transport of the excreta of towns. Water is the moving power or carrier, and its supply and application form an essential branch of the same subject, with the drainage of the place.

The inhabitants of Lancaster obtain their supplies of water from two sources—wells, and the roofs of buildings. The well water is brought up, for the most part, by pumps; there are a few small open wells in the poorer districts, from which water is drawn up by hand-labour and the bucket. The rain-water from the roofs of the dwellings is, in most cases, conveyed by spouts into cisterns or water-butts. The general prevalence of this arrangement is due to the hardness of the well or pump-water,* which unfits it for washing clothes, except by the addition of an alkali, which is usually the subcarbonate of soda; and amongst the poorer classes, where the apparatus for collecting the rain water is least efficient, and often wanting, the purchase of soda to make the pump or well water fit for washing, subjects them to a tax of one penny per week on the average. They complain also of the greater difficulty, when the spring water is thus softened, of getting out the dirt, and the quicker wear and tear of the clothes in washing, besides their being made more rotten by the soda, which also spoils or discharges the colour.

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* See First Report, vol. ii., pp. 319, 349, 414. A temporary abatement of the evil might be obtained by frequent, regular, and systematic cleansing and removal of the offensive matter from all courts, alleys, and yards, by properly appointed and responsible scavengers, the material removed being sold to defray the expense of the scavenging. The example of the small town of Dalkeith encourages the adoption of such a system on economical grounds. This town contains about 5200 inhabitants. Every street, court, and alley, is regularly cleansed, and thoroughly, every week-day, and on Saturdays twice (morning and evening); the sale of the manure produces a sufficient sum to defray the whole of the expense, and leaves a balance of about 100*l.* a-year.

The wife of an operative, with a cleanly house and habits, stated to me that she gave sixpence a pound for the soda, and used about a quarter of a pound for each week's washing, but the majority can only afford to buy it by the quarter of a pound or ounce; and though paying dearer for it in this way, yet using less, and washing with more labour, but less efficiently, their soda tax is thus reduced to one penny or one halfpenny per week, the average being, as before stated, one penny per week. In some newly-erected blocks of cottages, built, however, on the objectionable system of back to back, the roof water is conveyed into a common stone cistern, from which the tenants draw their supplies for washing by a cock. More commonly, however, in the older courts and alleys, the roof water is either imperfectly caught in insufficient quantity in cans or buckets, held under the open spout during rain, or it runs to waste, and adds to the unhealthiness of the locality by augmenting the stagnant kennel-pools and the general dampness of the soil and atmosphere. Most of the courts, alleys, or blocks of cottages are provided with their pump: those, however, in the neighbourhood of Stone Well and Calkeld Well, including about 200 houses, are without that convenience, and the inhabitants resort to the common pumps of those ancient wells, some from a distance of 200 yards: the water thence supplied is hard.

The wells in those courts and alleys provided with a pump, yield water not only hard and unfit for washing, but frequently unwholesome. A poor decent woman, of cleanly and apparently temperate habits, in *Lucy-court*, said, that the water from the pump in that court always made her ill, griped, and purged her; and she fetched water for tea, and other culinary purposes, from the pump in *Pipe-house-yard*, a distance of about 250 yards. The well in Lucy-court was polluted by the immediate vicinity of the midden-stead of the court, receiving the privy soil, which was allowed to accumulate in great quantity, not being removed oftener than once or twice a year. Far from being infrequent were the complaints that "the well was down," or the pump out of repair. In one court, observing a chain across the pump handle, the cause was stated to be, that the landlord having refused to repair the pump, the tenants of the court had agreed to to get it done at sixpence each. The repairs were made and paid for by those who had advanced the needful sum—the small capitalists of the court. The defaulters were "locked out" of the use of the pump, till they had paid their quota of the expense, or had wearied out the privileged tenants by incessant squabbling.

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* Mr. Wilson, chemist, found in the water from his own well in Great John-street, 20 grains of calcareous and other impurities in half a pint of the water.

These details may be deemed trifling, but they contribute to demonstrate the various evils of the present system, and become important when the ascertained cost at which good water, fit for every purpose, might be brought abundantly and conveniently into the dwellings of the poor,[*] is contrasted with the expenses and other evils involved in the present incomplete and inconvenient supply of water, of so hard a quality, as to be unfit for one of its most important applications.

In the first court leading out of *Monmouth-street* there is no pump or well; the only supply of water is from the roofs, and this is very partially collected. Most of the tenants complained of having neither hard nor soft water. Considering the trouble and labour, the colds caught in bad weather, and the wear of shoes, incident on having to fetch the water from a distant well, and the present expense of soda in making it fit for washing, one of the tenants (Mrs. Sanger) thought, that if good, drinkable, and soft water, were brought to her house by a pipe, she would not mind paying threepence a-week: the rent of her tenement was 2*s.* 4*d.* per week. The next-door neighbour, to secure a supply of rain water, which, nevertheless, had often failed her during

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[*] See First Report, evidence of Mr. Hawksley, vol. ii., pp. 38, 47. By way of contrast I subjoin the following estimate of the expense, in Lancaster, of the pump and well for obtaining the supply of the hard water:—

	£.	s.	d.
Cost of making a stone well complete, at 14s. per lineal yard, average depth 14 yards	9	16	0
Lead pump and wood frame	7	0	0
Stone trough complete	1	0	0
	£17	16	0
Average cost of annual repairs	0	5	0

Number of pumps and wells in the town, 1237.

Mr. Edmund Sharpe, to whom I am indebted for the above estimate, informs me that about 50 of the above pumps are not in use from various causes, as "out of repair," "water bad," &c.

The following gives the expense of the existing apparatus for collecting the rain water, exclusive of the roof-conduits and spouts:—

Water Butt.

	£.	s.	d.
Average cost	1	0	0
Annual repairs	0	7	0
Will last	12 years.		
Number in use	1850		

Lead Cisterns.

Average cost	£10	10	0
Number in the town	500		

Stone Cisterns.

Average Cost	£8	8	0
Number in the town	200		

500 houses have lead cisterns.
200 houses have stone cisterns.
1000 houses above 10*l.*, with each a butt.
850 houses under 10*l.*; 425 of them have each a water-butt; 425 have one to two houses.
850 houses under 7*l.*, with one butt to four houses.

3400 Total number of houses.

Average number of weeks' drought &c.—
Summer . . 6
Frost . . 2
— 8 weeks.

Price of water during drought, 1*d.* per 9 gallons.

the present dry summer, had invested fourteen shillings of hard earned savings in a second-hand butt.

Near the blind end of this court stood the common privy, with the usual enormous accumulation of ash and midden refuse. It was removed by hard labour, the wheelbarrow and cart, once or twice a year; the smell at such times being most offensive. A stagnant kennel surface drain, receiving oozings from the midden-stead, the slops from the houses, and the waste roof water, communicated with an untrapped gully-hole at the narrow entry to the court. I was not surprised when the Dispensary Resident Medical Officer, detailing his experience of practice derived from this locality, pointed out one of the houses as having been the seat of a series of cases of scarlet fever of a low typhoid type, fatal to one of the inmates, an adult, who had been attacked at a period when his labour had become most productive to the public, and important to his family.

In *Pitt-street*, the inhabitants complained that the pump was out of order, and that the water was bad and unfit for culinary purposes, when raised by much labour; there were no means for collecting the rain water in this street. The well water was used for washing clothes, after the addition of soda, for which each family in this street paid on the average one penny per week.

There are three inhabited cellars in this street.

The privy receptacles were in front of the houses, and brim-full: they are emptied about once in two years.

In *Oven-house-yard*, China-lane, I found lamentable instances of the difficulties of obtaining a supply of soft water for the indispensable need of cleanliness. One poor woman, upon interrogation, with some reluctance, pointed out an empty window pane on the level of the floor of an adjoining yard, through which she sometimes put her little boy at night, to abstract a supply from the water-butt there. At other times she got it from the Castle ditch, by letting down a bucket from the terrace, at a height of about 30 feet. This is not an uncommon practice with the poor women in the neighbourhood of the Castle; the part of the ditch not bounded by the terrace is railed in to preserve the water for the service of the jail. Soft water is sold in this neighbourhood to the poor who can afford to buy it, at a penny for three cans full.

James-street is long and narrow, with an open drain, and bears, at the Infirmary, the character of an unhealthy locality. *Barrow's-court* leading out of an offset from this street, has furnished cases of fever from No. 9, at the back of which house there is a huge midden belonging to the stables of the Fleece Inn. The mother of the family had been lately carried off by typhus. As exemplifying the appreciation of the advantage of a good supply of water, the tenant, though aware of the unhealthiness of the place, continues, because the landlord has provided a large stone tank for the reception of the rain water; it is raised by a pump from the tank.

In *Plough-yard*, already cited, as exemplifying the evils of the present sewer system, the means for collecting the rain water are very insufficient. The water from the pump is made usable for washing by the usual addition of soda. The tenant of two rooms in one of the houses rented at 1*s*. 10*d*. per week, paid three halfpence per week for soda for washing, when there was no rain water to be had. Another bought a pennyworth of soda for her week's washing.

Crooked-billet-yard communicates with the lower end of Church-street; is a similar, but narrower, *cul-de-sac* than Plough-yard, and has the privy and offensive midden-stead at the blind end: the contents are removed about three times a-year, the farmer paying 2*s*. 6*d*., which the inhabitants share amongst themselves. They complained of its offensiveness. One abode, of which the door and only window opened close against the midden-heap, had supplied the Dispensary with an interesting but fatal case of purpura hæmorrhagica, in a child: the mother, in the same abode, had been carried off by puerperal fever of the typhoid type. Here, after the usual complaints of the quality and deficiency of water, a tenant of the court, in answer to the question of what it would be worth to her to have a house supply of good water, thought that "twopence a week would be what most of 'em would be glad to give for such a comfort." This court had surface drainage only.

In *Oven-house-yard*, St. Leonard-gate, there is no pump, and they have a long way to go for water; and what they get from Stone Well or Calkeld Well is hard, and requires soda for washing. This yard is accessible by a narrow entry, close to which stood the usual open midden-heap; it leads to an area, about 80 feet by 20 feet, which is principally occupied by a stagnant mass of mud and green-mantled water. On one side of this were ten pig-sties, and the rest was surrounded by dung-heaps, of which I counted six. The central pool receives the fetid oozings from these accumulations of filth; and the whole forms a typical specimen of the fertile source of febrile miasmata, in the precincts of a populous neighbourhood.

Dam-side-street is another irregular enclosed space, entered by a covered way which we could not pass without stooping: it contained several midden-steads and pig-sties, and is a noted seat of fever. It is not provided with a pump: the inhabitants fetch their hard water from Mason-street, and their rain water, when they can get it, which is a rare occurrence, from Swarbrick's, in Germany-street; most times they have only the hard pump water, and those that can afford it, buy a halfpenny or penny worth of soda, which serves only for one batch of washing.

In *Croft's-yard* there is no pump, and the means for catching the rain water are very imperfect. Cleansing of the court always requires the preliminary labour of fetching the water from the Stone Well; and, at the period of the removal of the midden-heap, "they are all day in getting it any way decent." The usual soda tax is paid at most times of the year to make the Stone Well water fit for washing. One family had left the yard because they were always ailing: their successors are now in a sickly state. The advice of the Medical Officer to these, his habitual patients, was uniformly to leave a place which had been an almost constant channel for the flow of the Dispensary charity fund, in the shape of their drugs, and the time and skill of their Resident Officer.

Ventilation.—When we consider the proportion of putrefactive and pestilential emanations which must be mingled with the atmosphere of confined courts and yards like those which have been described, it is obvious that any of the modes of ventilation that have been devised and recommended to be introduced into the construction of the dwellings of the poor, by apertures, regulated or otherwise, in the windows, walls, and chimneys of dwellings so located, must increase the nuisance to the inhabitants by the introduction of currents of such offensive atmosphere, so long as the system of open privies and infrequent removal of the accumulated excreta and refuse is suffered to continue in operation.

Pure air is the essential condition of successful ventilation. An arrangement of dwellings admitting full and free currents of the atmosphere is the main requisite for the healthy respiration of the inmates, and should be provided for in all sanatory regulations for the future erection of abodes for the poorer classes. The improvement of the air in the existing dwellings when they are so arranged as to obstruct pure atmospheric currents, by the introduction of partial and domestic contrivances for ventilation, demands as a requisite preliminary, such a system of constant, speedy, and complete removal of decomposing animal and vegetable refuse as is now in operation in the town of Dalkeith (see *ante*, p. 225), or as that still more effectual and economical one which has been described in the evidence of Messrs. Foden,* Hawksley,† and Austin,‡ and which is actually in successful operation in a densely inhabited part of the locality now reported on—the County Gaol, to which I shall presently advert. With regard to the confined parts of the town inhabited by the poorer classes, I subjoin some of the instances in which the necessity for such an essential preliminary, connected with the flushing system of drainage and sewage, was forced upon my attention during the inspection made for the present Report.

In *Victoria-place* the first story of the houses is below the level of the opposite field, and about 7 feet below the wall supporting the soil of that field: the length of the place or passage is 40 feet, and it is blocked up at each end. The families living here are mostly of the better class of operatives. No. 7 is built over a stable and pig-sty, and has a great accumulation of refuse beneath the inhabited part of the house. The former inmates of this tenement were always ailing: their successors had been six weeks in the house, and complained that they were forced to keep the windows shut to keep out the stench.

The entry to a thickly populated *cul-de-sac* called *Railway Inn-yard*, is a covered passage two feet wide. *Cardwell's-yard* is a similar inhabited sunken shaft. The ventilation in both is most defective, and their atmosphere, polluted by the common open privy and open drain system, is unfit for admission into human abodes. Both localities had supplied the Dispensary with cases of fever and phthisis. Mr. Ricketts had had fever cases also in *Black Cat-yard*, which is five feet wide, and with an atmosphere requiring the same thorough system of disinfection.

Fleet-street is an enclosed area of a few yards square, entered from Union-square by a passage two feet wide, and 20 feet high. In this limited space were two privies and midden-heaps. The inhabitants carefully shut out the atmosphere which receives the emanations.

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* First Report, vol. ii. p. 349. † Ibid, 319. ‡ Ibid, 414

Lawson's-yard, inhabited by a higher class of operatives, was clean and flagged, but exhibited the evils of a pent-up atmosphere: it is narrow and closed at both ends, except the tunnel entry from Market-street. I was struck by the dank smell on entering it. My medical companion stated that he had noticed that of sulphuretted hydrogen in his attendance on the sick in this yard.

Several courts led by narrow covered ways from *Henry-street*: only one was sufficiently open to admit the purifying currents of air; the others were confined and filled by a more or less fetid atmosphere. Here was repeated the common complaint of the pump out of repair, and the great labour of raising water for culinary purposes. The proximity of the canal affords the supply of soft water for washing.

The obstruction to a free admission of solar light which is, likewise, caused by the close collocation of dwellings, as has been described, adds to the force with which the more directly deleterious influences operate upon the inhabitants, and especially upon convalescents, infants, and young children.

In regard to the close courts, yards, and alleys, so common in old towns, and so difficult to be effectually altered without destruction of property, the substitution of the soil-pan and flushing system for the open privies and accumulations appears to be the essential preliminary step to ventilation improvements. The atmosphere of the rooms, now often purposely pent up, is however, in some instances, rendered still more deleterious, especially during the hours of sleep, by the overcrowding of the apartments; of which I met not unfrequently with examples by no means warranted or excused by the circumstances of the occupant of such abodes.

In *Factory-hill*, for example, there is a block of eighteen cottages, built back to back. Mr. Ricketts, who had here attended some bad cases of children's diseases, drew my attention to the uncleanly state of some of the abodes; and Mr. Jackson, the mill-owner, complains that he could not prevent the habit of over-crowding. Two or three families would stow themselves into a space fit only for the wholesome occupation of one family; and, though in the receipt of full wages, would thus save expense of rent at the expense of health, in order to gain means of indulging in excesses calculated more directly to undermine the constitution.

While, however, a general system of baneful extraneous causes continues to operate in diminishing or destroying the domestic comfort of the working classes, by polluting the atmosphere surrounding their dwellings by noxious emanations, which tend directly to depress the nervous system, no very sanguine expectations can be entertained of their improvement. The great and primary evil must first be amended by efficient sanatory regulations.

Fires.—Among many secondary evils and inconveniences which attend the present mode of supply of water in the town of Lancaster, its inadequacy to meet the emergency of conflagrations prominently suggests itself. "The town," says the historian above quoted, "has been long famous for the great quantities of mahogany furniture which have been made in it for home use and exportation. Mr. Gowlli's extensive warerooms, stored with every article of useful and ornamental furniture, are well worth the attention of the stranger, as they are said to be the best stocked of any in this line out of the metropolis."[*] I was assured by the present senior partner of the firm, that in the event of a fire breaking out in the richly-stored premises in Church-street, the only supply of water which could now be had was from the pump and water-butt, and from those in the yards and passages of the neighbouring houses.

Public Walks.—On the rising ground to the east of the town, near that part which is most densely inhabited by the factory population, the Corporation possesses land, called Freeman's Wood, which has been planted and walled round for the protection of the young trees. This might be laid out, at a comparatively small expense, as an ornamental park for public recreation. It could not but prove conducive to the sanatory improvement of the labouring population generally, and more especially of the manufacturing class, which the tables of mortality show to have, at present, the lowest rate of life. The higher ground, near the race-course, would form, if properly drained, a most advantageous site for athletic games and exercises, which are too little encouraged amongst the younger artisans and operatives. These, and other accessary means of improving the sanatory state, can scarcely, however, be expected to improve the rates of mortality, whilst the great and primary evils remain in full force.

Remedial Suggestions.—The most obvious, and apparently the only efficient remedy for the circumstances which mainly affect the sanatory condition of the town of Lancaster, depends upon the acquisition of a supply of water, not merely in quantities sufficient for the ordinary domestic wants of the inhabitants, but a concentrated supply, capable of being conveyed into the interior of houses so as to be applicable to the removal of the most offensive kind of refuse, and of conveying the same, by proper house-drains, to sewers, so constructed as to admit of effectual scouring by such application of water-power.[†] The whole refuse of the town, thus speedily and effectually carried off by a flushing system of house-drains and sewers, ought, in order to meet the exigencies of the agricultural neighbourhood, as well as to ensure a return for capital expended in such sanatory improvements, to be conveyed by the main sewer into reservoirs, at a due remoteness from the town, in order to its subsequent removal and application to the increase of the productiveness of the surrounding land, which might, if properly drained, be then maintained constantly in a high state of fertility.

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[*] An Historical Account of the town of Lancaster, 8vo., 1807, p. 64.

[†] Mr. Sharpe, county architect and surveyor, in a letter addressed to me since my survey of the town, says, in reference to such a supply of good soft spring-water:—"I am unable to give an estimate of the cost of a perfect supply, but I am satisfied that it could be obtained at a very reasonable rate. The lower part of the workhouse field would form an excellent high-level reservoir, and the Freeman's Wood, immediately below it, a very good site for a low-level supply. Both would be fed by small streams, and would be supplied from large surface drainage reservoirs on the Lancaster or race-course side of the base of Clougha." The masses of the sandstones of the carboniferous series on which the subsoil of the town rests, here rise to the surface and form the base of this hill, the level of which base is higher than the summits of the church and castle towers which crown the hill on which Lancaster is built.

I have been induced to step thus far beyond the immediate and proper object of this Report, which is the exposition of the chief causes affecting the sanatory condition of Lancaster, and to suggest the line of remedial operation, because the local authorities, responsible for the health of the town as far as it depends on proper sewage and drainage, have an opportunity of judging of the efficiency of the improved system recommended, by its successful operation at the County Jail, where it has been adopted by the authorities who regulate the sanatory condition of that establishment.

All the excreta of the population there aggregated, and immured upon the summit of the hill on which the town is built, are speedily and effectually removed by the application of water-power, and conveyed to closed reservoirs, to be subsequently applied to the purposes of agriculture.

The following are the sources whence a water supply, equivalent to the above important service, as well as to the ordinary exigencies of cleanliness, is obtained:—

Debtors' Yard.—Spring water from the well in the centre of the yard, and from a well near the Well Tower. Rain water from a large tank at the upper end of the yard.

Male Crown Side.—Spring water from the well in the Chapel yard, worked by the tread-wheel. Rain water from a tank in the Lungess Tower; from two tanks in B ward; from a tank in each of the wards A, C, D, E, and F; and with water, condensed from the steam-pipe, passing through the wards, in the yard of ward G and H.

Penitentiary, or Females' Ward.—Spring water from a well within the building. Rain water from the Castle ditch, by a forcing pump, from two tanks on the roof, and from a large tank in the yard.

Female Debtors' Ward contains a rain water tank.

Keeper's House.—Spring water from a well in the Well Tower. Rain water from a tank under the house.

The inconveniences of the flushing system of sewage adopted in the jail, of which I heard complaints in the town, arise entirely from the partial application of the system, from its being confined to the jail and stopping at the summit, instead of extending to the base of the hill, and over the whole natural drainage area of the town.

The contents of the flushed drains and sewers of the jail, instead of being delivered at a distance from the town habitations, are arrestep and accumulated in two enormous cesspools, excavated just outside the walls of the jail, on the summit of the hill, whence the matter is removed and carried off at brief intervals. The constant and frequent repetition of such an operation within the town, is, of itself, a nuisance, and opposed to the salubrity of the atmosphere. But the cesspools were, likewise, complained of by the inhabitants of the streets in the immediate vicinity, on account of the occasional overflow of the liquid contents which found their way into both the kennels or surface drains, and into the sewers; and the effluvia from the untrapped gratings were stated to have been thereby rendered much more noisome and offensive.

The authorities having charge of the town drainage and sewage, at the period of my inspection of the sanatory state of Lancaster, had refused to permit the authorities having charge of the upper part of the same natural drainage area, to use the sewers which constituted the proper outfalls. At different previous periods, the subject of a combined plan of sewage, of both town and castle, had been under discussion between the two authorities, but has not, hitherto, led to so desirable a result.

With the present mode of water supply, the extension of the flushing system of drainage and sewage over the entire drainage area of the town, is, in fact, impracticable. Equally impracticable, without a different and improved mode of water supply to the town is the substitution, for the present open-privy and putrefactive-accumulation system in the courts and alleys inhabited by the labouring population, of the plan above recommended, on the evidence of Messrs. Hawksley, Foden, and Austin, and which is in successful operation at the commencement of the natural drainage system of the town, namely, at its summit.

The general manifestation of a hearty sympathy on the part of the influential inhabitants of Lancaster with the welfare of the humbler classes, and the strong expressions of interest in the subjects of the present inquiry, and of desire for the improvement suggested by it, justify the expectation that that which has been done on principles of economy, for the sanatory condition of the inmates of the jail, will be attempted, its equal economy and efficiency being made manifest to the authorities, in behoof of the health, the cleanliness, the domestic comfort, and the morals of the honest and industrious poor.

In the town of Nottingham, more than 5000 houses of the labouring classes are supplied with filtered water, fit for every purpose, at high pressure rate, for which the rate of one penny per week per house is remunerative: this has been followed by great increase of personal cleanliness and decrease of disease. I met with many instances among the analogous classes in Lancaster, of expressed willingness to pay twice that sum, or more, for the like advantage; and, at the same time had evidence, that an expense equal to that paid for water, by the poor at Nottingham, was in most cases incurred by the poor at Lancaster, for improvement of their present scanty supply of hard water. The effect of such scanty supply, obtained with out-door labour, sometimes at a distance and with much difficulty, with subsequent superadded expense to render the water usable for washing by addition of an alkali injurious to the articles washed—must be to diminish, if not destroy, habits of cleanliness, both of attire, person, and abode.

REPORT

ON

THE STATE OF WOOLWICH AND SALISBURY.

By W. T. DENISON, Captain R.E.

ONE OF THE COMMISSIONERS APPOINTED BY HER MAJESTY FOR INQUIRING INTO THE STATE OF LARGE TOWNS AND POPULOUS DISTRICTS IN ENGLAND AND WALES.

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REPORT *on the* SANATORY CONDITION *of the* TOWN *of* WOOLWICH.

By W. T. Denison, Captain Royal Engineers.

My Lords and Gentlemen,—

The following Report which I now submit for your consideration is chiefly founded upon the information received from individuals and public bodies, in reply to the printed list of questions drawn up and circulated under your direction. These answers, and some others which have been given to a few separate questions submitted by me to the medical practitioners in the town, would alone afford a pretty correct view of the state of the town. But as regards those points which have the most direct operation upon the health of the public, I shall be able, from my own observation as a resident for upwards of seven years, to correct some of the statements contained in the answers to the printed queries, and to corroborate the evidence of the medical practitioners as to causes of the diseases stated to prevail to a great extent in particular localities, and which can fairly be traced to the filthy state of the streets and alleys arising from the total absence of drainage, the neglect of proper cleansing the surface by scavengers, and the prevalence of dirty habits among the population, arising principally from want of water.

I am happy, however, to be able to state, that a conviction of the evils arising from these various causes appears now to prevail among the local authorities. Notice has been given of an intention on their part to apply to Parliament for an extension of the powers of their present local Act, so as to enable them to drain the town properly. This si a step in the right direction; but to make it perfectly effectual, the whole subject should be carefully considered by competent persons, and the powers taken should be such as would allow the authorities to provide proper supplies of water, without which any system of drainage can be but partially carried out. The steps now taken by the authorities afford a most satisfactory proof of their anxiety to co-operate with the objects of the present inquiry.*

Position of the Town.

The town of Woolwich is situated on the south bank of the river Thames, about eight miles below London Bridge: it occupies a portion of the steep bank or ridge which extends from Greenwich to Erith, and which is composed for the most part of gravel and sand overlying the chalk. The fall is rapid towards the river; at one or two points the water comes close up to the foot of the ridge, but generally there is a broad strip of marsh land between the ridge and the river. This marsh land is below the level of high-water mark, but is protected from inundation by banks carefully constructed, and kept in repair by a heavy rate levied upon the land which derives a benefit from them. Though thus protected from actual inundation, yet the stagnant water in the ditches, and other circumstances attendant upon such a locality, create in the spring and autumn a tendency towards intermittent fevers in the inhabitants of the villages which border upon the marsh, and from this the inhabitants of Woolwich do not altogether escape, though it attacks only those who live in the lower parts of the town.

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* Since this Report was made it has been resolved not to incur the expense of obtaining a separate Act of Parliament, in the expectation that some general measure might be passed.

A portion of the town of Woolwich is built on the top and the slopes of the ridge, but the most densely peopled portion lies on the alluvial flat between this and the river.

The population of Woolwich in 1841 amounted to 26,311, including the military: in 1831 it amounted to 17,661, showing an increase of 8650, or 49 per cent. in 10 years.

The whole, or by far the larger part of this population, may be said to be supported by the large Government establishments connected with the army and navy. The Dockyard finds employment for a large number of men; the Royal Arsenal and other establishments connected with the Ordnance Department have many workmen steadily employed; and the garrison, including artillery, sappers and miners, and marines, may amount on an average to 3600. These, then, from the nature of their occupation, are not liable to the vicissitudes to which the inhabitants of a town, dependent upon trade or manufactures, must occasionally be subject. Their employment is constant, their wages moderate, in some instances high, so that distress among this class of workmen must in general arise from improvidence or habits of intemperance; but there is still a large class consisting of daily labourers, finding employment in the summer only; of the wives and children of soldiers, who by the regulations of the service cannot be sent with their husbands or fathers to the foreign stations when they go upon duty; and of the widows and children of those same soldiers who die, leaving nothing for their families. The aggregate of these form a pauper population which presses heavily upon the poor-rate, and among whom, crowded as they are in small, ill-ventilated dwellings, disease in its most fatal form is always found to prevail.

From some returns to me by Dr. Bossey, and which seem to have been drawn up with great care, it appears that the per centage of deaths among the male population of Woolwich in 1841 amounted to 2·332, while that of the female population was only 1·790. The per centage throughout England being in the same year—

Males	2·238 per cent.
Females . . .	2·083 per cent.

Dr. Bossey does not attempt to account for the smaller proportion of female deaths, which appear to place Woolwich on a par with some of the healthiest parts of England, while the male population, on the contrary, appear to be less healthy than the average. The fact as regards the males may be accounted for by the existence of a military and naval hospital, and two convict ships, the deaths in which of course appear to swell the average. Making a proper allowance for these, it will appear that Woolwich stands high in the list of healthy towns.

[illegible] the Report of the Registrar-General, containing an abstract of the deaths registered in the different districts in 1841, it appears that the per centage of deaths in the two districts into which Woolwich is divided differed materially from each other.

In the one district the population amounted to 13,367 and the deaths to 377, giving a per centage of 2·8; but as this district included the hospital of the Royal Artillery, and the convict hospital ship, if we deduct the deaths which took place in these, amounting to about 100, and make also the necessary deductions from the population, the per centage will be reduced to 2·13. In the other district the population amounted to 12,418, and the deaths to 172, giving a per centage of 1·4.

This is a most striking difference, and it can only be accounted for by considering the relative positions of the two districts. The one exhibiting the smaller per centage is situated on the top and slope of the ridge, and the inhabitants are for the most part composed of those classes who may be fairly supposed from their position in life to be withdrawn from the influence of several of the causes which operate most deleteriously upon the health; while the other, showing the large per centage of deaths, occupies the alluvial flat between the ridge and the river, and is inhabited principally by the working classes.

Making, however, every allowance for what may be termed the natural advantages of one district over the other, there yet remains a very large balance against the lower district, which can only be accounted for by the operation of what may be called artificial causes, or such as it would be in the power of legislation to mitigate or remove—such as neglect of drainage or cleansing, faulty construction of houses, deficient supply of water, &c.

I will now, therefore, proceed to consider the present state of the town as regards the important points of drainage and cleansing, supply of water, construction of houses, and ventilation.

The general superintendence of the draining, paving, cleansing, and lighting the town, is vested by the local Act 47 Geo. III. cap. 3, in the hand of 30 Commissioners, who are elected annually by the rate-payers. By the terms of the Act the Commissioners are empowered to levy a rate not exceeding in any one year one shilling in the pound on the rental of the parish, and by this rate a sum of from 1800*l.* to 2000*l.* is annually raised for the purposes before mentioned. As far as regards drainage, no town can be more favourably situated than Woolwich. Standing on the slope of a hill, on the bank of a river where there is an average rise and fall of tide of 15 feet, no difficulty will be found by the engineer in arranging for the perfect cleansing of the whole town. As it is, however, all these advantages have been overlooked; and I do not suppose there is any town with the same number of inhabitants in which, as far as regards drainage, less has been done than in Woolwich.

Of sewers, properly so called, there are three; two of these have been made by the Government, at a great expense, to convey the soil from the Artillery and Marine Barracks to the river. The third was constructed in a new street built a few years ago. The Government authorities have never made any objection, when applied to, to allow the drains from private houses to connect with these sewers; but the owners of houses have very seldom availed themselves of this advantage, preferring, in most instances, to excavate cesspools, and to depend upon the porous nature of the subsoil, which has become saturated with fæcal matter.

Of drains to carry off the surface-water there are several in the lower parts of the town, which would otherwise, in heavy rains, be completely flooded by the rush of water from the high ground; but in the upper part of the town, and on the slope of the hill, the side gutters of the streets receive all the surface drainage, the waste water from the houses, and in many instances the overflowings from the cesspools of the privies. Indeed, complaints are constantly made to the authorities of the nuisance arising from this very cause, in the lower as well as the upper part of the town, and they have attempted by fines and similar means to induce individuals to abate the nuisance caused by their neglect; but hitherto without much effect. To make matters worse, these gutters are seldom effectually cleansed except in rainy weather, when a rush of water from the high ground acts as a scour and washes all the impurities from the higher to the lower part of the town.

The materials of which the largest portion of the streets or roadway is composed render any attempt to cleanse or sweep them unavailing; a loose, badly-binding gravel, procured in the neighbourhood, which in summer is soon reduced to dust, and in wet weather to mud, is the material commonly employed, and this, especially on the slope of the hill, is soon washed by heavy rains into the gutters, choking them up, and causing their contents to spread over the roadway; and what is called cleansing the roads most commonly consists in emptying and cleaning out these gutters and throwing the contents back again into the roadway. A large sum is annually spent in maintaining the roads and in scavenging; but while so little is done in the latter branch in the main streets and principal thoroughfares, it can hardly be expected that the narrower streets, courts, and alleys should be left in better condition; and a very slight acquaintance with these portions of the town will be sufficient to show the very small amount of labour bestowed upon them.

In point of fact, the Commissioners cannot be said to have done much towards carrying out the objects for which the Act was granted. Indeed, with the exception of lighting the town, (which is now properly done, with gas in great measure,) all the other objects before mentioned, such as drainage, paving, and cleansing, have been most inefficiently performed.*

Supply of Water.—Water is supplied to about one-third of the houses in Woolwich by the Kent Waterworks Company, who derive their supply from the Ravensbourne, above Deptford. The water is of good quality, perhaps a little hard; but after rainy weather it is so discoloured, and contains so much extraneous matter, as to render a filter a matter of necessity. It is pumped up by a steam-engine to the heights required, and there are two reservoirs at an altitude sufficient to supply most of the town in case of fire. Another is now constructing at a much greater elevation, which, although partly for the benefit of the Dockyard, will yet afford additional security to the town.

The quantity of water furnished by the Company is scanty, and the rates are high. The water is laid on three times a-week for about one hour, or one hour and a half at a time, and those who have tanks in their houses have them filled; a large proportion, however, of the poorer class of people, to whom an ample supply of water would be most peculiarly useful, are compelled to derive their supply from the stand-pipes in the streets, and as the vessels in which they can preserve this water are generally few in number and of small capacity, it cannot be expected that such use should be made of it as health and cleanliness imperatively demand.

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* This may partly arise from the smallness of the means at their disposal, but it is also owing in part to circumstances connected with the constitution of the body.

The Company professes to put no limit to the quantity taken during the time the cocks are open; but practically the supply is limited by the capacity of the tanks, which are generally furnished with ball-cocks. At the stand pipes there is always a sufficient number of people to be supplied to ensure that the water is kept running during the whole period that it is on; but the quantity discharged varies very much, in some instances being very small. The following are the rates charged, and the quantities supplied to two houses furnished with tanks:—Two cisterns, containing 100 gallons, rent 2*l.* per annum, price per 100 gallons, 3*d.*; two cisterns, 260 gallons, rate 4*l.* 4*s.*, rate per 100 gallons 2½*d.*

These prices, of course, imply that the tanks are filled full, and are emptied in the interval between the times of supply, which is by no means the case.

The supply furnished by the stand-pipes was gauged in three instances.

1st. A stand-pipe delivered 2⅛ gallons in 55 seconds, or at the rate of 2⅜ gallons per minute.

2nd. Another discharged 2·9 gallons in 38 seconds, or at the rate of 4·6 gallons per minute.

3rd. Another discharged 3·15 gallons in 16 seconds, or at the rate of 11·8 gallons per minute.

In some instances, I understand, 5*l.* per annum is paid to the Company for the stand-pipe; but while the discharge appears so irregular, it would be impossible to put a fair value upon the use of such a pipe. In one instance the price would amount to 3·2*d.* per 100 gallons, while in another the same quantity would only cost ¾*d.*; these prices being computed on the supposition that the cocks remain open 1½ hours: but this, I believe, to be by no means the general rule.

By the answers to the queries furnished by the Kent Waterworks Company, it appears that they furnish a supply to about one-third of the number of houses in Woolwich; the others are supplied partly by wells and springs, partly by rain-water butts; and there are several families who depend upon the charity of others for this most essential necessary, or are obliged to purchase from the water-carriers at the price of a halfpenny per bucket. From the small extent of the supply, and the mode in which it is furnished, it is evident that no application of water can be made to any other than common household purposes. None is taken to water the streets even in the driest weather, and the people of Woolwich are content to submit to pay dearly for a very insufficient supply of one of the principal necessaries of life, while the means of affording an ample and constant supply are quite within their reach. By excavating at the lower part of the town to a short distance in the chalk, a supply fully adequate to all the wants of the present population of Woolwich would be found; and the cost of laying down the pipes and services, constructing reservoir, and erecting engines of the requisite power, would not, in all probability, amount to as much as 20,000*l.* The annual interest of this sum, at five per cent., the cost of working the engines, and the establishment necessary to keep the works in repair, would not amount to above 1600*l.* per annum; and for this sum, which would not amount to above nine shillings per house, supposing every house was charged at the same rate, a full and ample supply of the best quality of water would be furnished, not merely at intervals of 48 or 72 hours, but at every hour of the day: and were the rate imposed, as it of course would be, in some proportion to the quantity consumed, it is not too much to say that the sum of one penny per week would be all that the poorer class of tenements would be called upon to pay.

I have entered more fully into the subject of the supply of water from the conviction that to the want of cleanliness, which is a necessary consequence of a deficiency of water, may be attributed many of the diseases which prevail among the lower classes. Baths, warm and cold, public establishments for washing, &c., would, with great ease, be created, were the supplies of water in the hands of the Commissioners of the town, or in some public body acting in behalf of the inhabitants. Baths, which are now a luxury hardly to be procured by the richer classes in Woolwich, would then become a necessary of life, and be placed within reach of the poor; and establishments for washing would, I have no doubt, be found to answer as well here as they have been found to do at Liverpool and elsewhere.

4th. Construction of houses, &c. &c.

The streets are generally pretty wide, and there is not much to complain of as regards the general arrangement of the buildings lately erected. In the older parts of the town there are several narrow alleys and courts, but these are generally open at both ends; and in very few instances are houses built back to back.

In the newest houses, however, but little attention has been paid by the builder to the health or comfort of those who are to inhabit them; the construction is of the slightest and flimsiest description, the materials of the worst quality, the timber of the minimum scantling consistent with safety; the size of the rooms small; in very many cases there is no provision for a supply of water, and no attempt is made to provide any drainage. Yet the rents demanded are very high. With the view of acquiring some information as to the manner in which the inhabitants are generally accommodated in their houses, an inquiry has been made to show the positions and dimensions of rooms, the amount of rent paid, the mode in which water is supplied, and the amount of water-rate paid. The total number of houses thus examined was 86; they were taken at random in different parts of the town as specimens of the class of buildings occupied by weekly tenants. In some instances a single family was found to occupy a whole house, but more generally each room was the abode of a family. The rooms are very generally small, always low, and badly ventilated; in many instances very crowded; in one case as many as 10 were found sleeping in one room, and that room a cellar. All the evils of the system of supply of water before detailed are exemplified in these houses.

Many of them have privies attached to them, but these in all cases discharge themselves into cesspools, and but little care is taken to empty these when they get filled; in some instances there is a privy common to four or five houses. And yet the rents demanded vary from a minimum of 1*s.* 6*d.* to a maximum of 3*s.* 3*d.* per week.

A return was furnished to me by the members of a District Visiting Society, into whose hands I placed a blank form, to be filled up. The number of houses included in this return amounted to 345; the number of families inhabiting them to 787; the individuals composing these families to 3231; or on an average 4¼ per family. Of these families only 42 inhabited cellars. The supply of water was in 134 instances derived from the Kent Waterworks Company; 144 families were supplied by wells and springs; 30 depended on rain-water; while 37 had no regular supply, but were obliged either to beg water or to purchase it at the rate of ½*d.* per bucket.

The drainage was in all cases complained of, and in some instances diseases were attributed to the noisome smell arising from decomposed matter in cesspools and gutters.

The following table, which is an abstract of the information furnished by the members of the District Society, as to the number of people occupying one room, shows the effect of high rent and low wages in condensing a population into the smallest possible compass. The returns show—

1 case of 11 in one room
2 cases of 10 ,,
4 cases of 9 ,,
19 cases of 8 ,,
23 cases of 7 ,,
25 cases of 6 ,,
29 cases of 5 ,,
41 cases of 4 ,,

To conclude: the points to which the attention of the authorities should be most particularly directed, with a view to the comforts and conveniences, especially of the lower classes, are—

1st. A complete and effective system of sewerage and drainage, in which provision should be made, not only for the surface drainage of the streets, but for the house-drainage also, with a view to the removal of every cesspool.

2nd. A proper and adequate supply of water to every house, available at all times, under sufficient pressure to raise it to the top of the highest building.

3rd. A sort of corollary to No. 2; the construction of public baths, and other domestic conveniences for the use of the lower orders.

4th. A better system of paving and cleansing the streets, lanes, and alleys.

There are several other points which would require consideration in case of the introduction of any general measure for sanatory improvement, but those above stated would, if honestly carried out with a view to the benefit of the town generally, and more particularly of the poorer classes of inhabitants, go far to remove many crying evils, and to restore Woolwich to the position, in a sanatory point of view, which, from its healthy situation and other local advantages, it is entitled to occupy.

REPORT *upon the* SANATORY CONDITION *of the* CITY *of* SALISBURY.

By W. T. Denison, Captain Royal Engineers.

In drawing up the Report which I now submit upon the sanatory condition of the city of Salisbury, I have derived much assistance from the answers to the questions furnished by different individuals resident in the city. The time that I could spare was not sufficient to enable me to enter into any very detailed investigations, but the few following remarks may serve to explain and elucidate some of the chief features which characterize this city:—

The population of Salisbury, that is, of the city, exclusive of the close, and the suburbs of Fisherton and Harnham, amounted in 1841 to 9490, at present, including these three places, formerly omitted, it would amount probably to 11,000.

The number of deaths registered in 1841 in the city amounted to 245, in 1842 to 320. The increase in the latter year being caused by small-pox, of which no less than 58 people died, 10 of whom had been previously vaccinated. In 1841, 34 died of scarlatina, 1 of scarlet fever, and 4 of typhus; while in 1842, the number of deaths from these three causes amounted only to 8. Taking the number of deaths in 1841, and the population of the same year, the mortality would appear to be 1 in 38·7, while, if an average of the two years 1841 and 1842 be taken, the mortality is 1 in 34; taking, however, the lowest rate, that of 1 in 38·7, which agrees with the return to the Registrar-General, of 2·6 per cent., a greater rate of mortality is shown to prevail in Salisbury than is found elsewhere in towns of the same character. The facts developed by the registry of deaths show the insufficiency of what would generally be considered the best evidence, viz., that of resident medical men, as to the healthiness or unhealthiness of a town. In the answer to the printed questions, it will be seen that nearly all those who gave any opinion on the subject, stated the town to be healthy, whereas, in point of fact, it is in that respect far below the average.

The general aspect of the town is favourable, the main streets are wide and well cleansed. The cleansing, paving, and lighting, &c., are in the hand of trustees, appointed according to the provisions of an Act passed in the 55th George III., and as far as the powers given by this Act extend, they appear to be exercised with judgment; but these powers do not extend beyond the thoroughfares of the town. The courts and alleys which run back from the main streets into the heart of the squares or chequers into which the town is divided, being private property, are altogether free from their control, and are very commonly in a most filthy state. I visited some of these, as Rooke's-yard and Perman's-yard. In the former I found 14 families living; not a single privy, either public or private, was provided. There was an attempt at drainage down the centre of the court, but the pavement was so rough and irregular, the drain so small, and with so little fall, and the gully-hole and grating so small, that a large portion of the refuse remained on the surface. The upper end of the yard I found to be a receptacle for every kind of filth, and it was used as a privy by the inhabitants.

Berman's-yard was nearly in as bad a state; both yards were supplied with water by pumps; but complaints were made of the quality of the water, which, lying close to the surface, I have no doubt was affected by the percolation of the filth from the alley.

The general drainage of the streets is well provided for in the lower part of the town, through which water-courses are taken, and these are well supplied with water from the river Avon above the town. The quantity of water passing down these water-courses is regulated by means of shuttles; when the mill-dam is full, there is a head of perhaps three feet against the shuttle, but when the pond is drawn down, or when the water is taken off for irrigation, there is not more than one foot; this, however, in addition to the general fall of the ground, is quite sufficient to scour out the main water-courses, and carry off all the impurities, entering them either in the street or from the small house-drains; these latter, for want of fall, are very often choaked, and the same thing happens to the drains in the courts and alleys, which, not being provided with a sufficient body of water, to scour them out occasionally, and having but a trifling fall to the main drain, are peculiarly liable to this accident; which, when it once occurs, will probably not be remedied for months. The trustees of the roads have no power to interfere; the occupiers are too poor to incur any expense in removing an evil to which habit has rendered them indifferent; and the landlords being in many cases also poor, and often as numerous as the houses, will not combine together, or act in any way for the mere benefit of the occupier.

The sweepings of the streets and cleansing of the drains are carried away by contract, the contractor being glad to remove them for their value as manure. The privies are cleansed by scavengers, who are willing to empty the cesspools for the value of the soil as manure, nay, in some cases they will even pay for the privilege.

Upon the whole, the management of the drainage and cleansing of the town, as far as the authority of the trustees extends, is performed in a creditable manner, and the high rate of mortality, indicated by the Mortuary Register, cannot be attributed to their neglect in working out the provisions of their local Act, but may be traced—

1stly. To the position of the town, in a low damp valley, in the midst of water meadows, and to the floods which are a necessary consequence. The evidence shows that, after a flood in 1841, typhus fever prevailed to a great extent.

2ndly. To the miserable state of the dwellings of the lower classes, their poverty and wretched condition. The evidence goes to show that the courts and alleys where these classes generally reside are in a filthy state, derive no benefit from the general system of cleansing carried on in the streets, and are little more than generators of atmospheric impurities. The remedies which it would be found possible to apply in Salisbury appear very simple. I am afraid that any attempt to improve the general drainage, so as to cause the water to pass off with greater rapidity, would be found impracticable; it would interfere with too many interests, and after all be of doubtful value; but the condition of

the residences of the poorer classes and a better system of cleansing, &c., might be carried out by an extension of the powers granted to the trustees under the local Act, empowering them to enter and cleanse the small courts and alleys which are now beyond their jurisdiction. In Salisbury the powers possessed by the magistrates and police over the lodging-houses appear to be very defective; there are no powers of supervision and inspection: even a system of licensing them might not be considered too stringent a measure as affording some guarantee for their being kept decently clean, and as enabling some check to be placed upon the numbers occasionally crowded together in them.

REPORT

ON

THE STATE OF NOTTINGHAM, COVENTRY, LEICESTER, DERBY, NORWICH, AND PORTSMOUTH.

By J. R. MARTIN, Esq.

ONE OF THE COMMISSIONERS APPOINTED BY HER MAJESTY FOR INQUIRING INTO THE STATE OF LARGE TOWNS AND POPULOUS DISTRICTS IN ENGLAND AND WALES.

REPORT *on the* SANATORY CONDITION *of the* LABOURING POPULATION *in the* TOWNS *of* NOTTINGHAM, COVENTRY, LEICESTER, DERBY, NORWICH, *and* PORTSMOUTH.

By J. R. MARTIN, Esq.

The manifold circumstances that affect health in the several towns allotted to my personal survey and examination as Commissioner, were fully detailed in the account of each separate town previously reported on by me; and I now beg to submit, not without much diffidence, the following remarks suggested by all that fell under my cognizance and observation during my tour of examination into the sanatory condition of the above six towns.

Hitherto such inquiries on my part have been principally conducted in countries and climates where the endemic influences, and all the external causes of disease, are of the most concentrated and powerful nature, and among masses of people differing in race, diet, habits, customs, morals and religion, from Europeans. But though in tropical climates, less favoured in many respects than that of England, the diseases and their causes are, comparatively, of such rapid and fatal effect, still, the principles on which measures of amelioration rest, and on which all plans of prevention must be founded, are the same. On these grounds I venture to hope that my observations may not be found altogether devoid of interest or of use.

Whether we regard the past history of naval and military health, or the existing sanatory condition of the labouring population in populous districts and towns, we shall find that many of the evils which formerly afflicted the first-named bodies, and which now afflict the latter classes, are derived from crowding and its accompanying evils. I here mean the condition of crowding of men in health. But when to this state we add crowding of the sick with each other and with the healthy—crowding of the living and the dead—filth—a noisome and impure air—deficiency in food, clothing, and fuel—a deficient and polluted supply of water—defective drainage and sewerage—with ill-constructed, crowded, and ill-arranged habitations and streets;—conditions under which the sensible qualities of the very blood are altered, while the vital powers are wasted and depressed:—in short, when whole masses of the community are found living in daily neglect alike of the laws of nature and of the means furnished by art; no wonder that disease, immorality, and death—no wonder that epidemic following closely on epidemic—aggravated forms of all those disorders that tend to abridge the term and usefulness of life—should be rife amongst the poorer classes inhabiting our towns and cities.

2. In the exclusively agricultural counties and districts of England, we find the annual mortality reduced to a minimum, whilst in such as are crowded with towns it attains to the highest rate known in this empire; the mortality ranging from one death in 54 to one death in 29 of the inhabitants annually; a deplorable example of the difference in physical condition and comfort of the respective classes of our labouring population. In districts of an average degree of salubrity

we find the deaths two per cent. per annum, while, in 114 districts of England it is 2·5; the mortality standing in the relation of 491,999 to 392,072 respectively; that is, the 99,927 of excess in the first number being referable to "defective sanatory regulation." It is reckoned, moreover, that, out of every 1000 births, 221 only die under five years of age in agricultural districts, while 385 die annually under five years of age, in consequence of the complicated causes in operation in all closely-built towns.

3. Certain trades and manufacturing occupations, over-exertion and fatigue in early life, defective sewerage and drainage, ill-ventilated and ill-constructed habitations, want of water, deficiency in quality and quantity of food, filth, bad habits of life, immorality—each and all have solely and exclusively been assigned as the cause of sickness and mortality amongst the labouring classes. But it is evident that to the assemblage of all these circumstances, and not to any one or two of them, must in reality be referred the calamities of disease and premature death in our towns and cities.

4. In Liverpool in 1840-41, the deaths in excess of two per cent., the average for the same year of the rural and other healthy districts were 10,050, in Leeds 3343, in Manchester 6917, in Alston and Oldham 3503, in Bolton 2228, and so on, in proportion, throughout all the towns and cities in the empire. In Birmingham we have 33,000, in Manchester 83,000, and in Liverpool 100,000 inhabitants to the square mile, the greatest mortality occurring in the last-mentioned city. It is quite evident, then, that to the circumstance of crowding must be ascribed much of the evil that afflicts the masses congregated in the manufacturing towns especially. I say "much," because I would not be supposed to refer to one cause only ills that result from the assemblage of many causes. Great injury to the interests of the manufacturing classes and to the cause of impartial inquiry has resulted from this one-sided and hasty manner of investigating questions affecting public health. It too often happens that on the discovery of a cause, perhaps but secondary in its nature, all further inquiry into other and far more powerful causes is suspended or forgotten. But though this is true, it cannot, at the same time, be concealed that the evils resulting from the occupations and mode of employment in large towns are enormous, though different in their mode of action from what has often been stated.

5. Resuming the comparison again, we find that, in a thousand deaths in the country districts, 202 persons the age of 70 years; while in Liverpool, for instance, but 90 persons out of 1000 attain to the same age; and, while the average age at death in agricultural Rutlandshire is 38 years, it is stated to be but 21 years in Liverpool. Taking the same population, it has been shown by the Registrar-General that in four years a greater number died in town districts than in country districts by 99,752. Again, out of 1,000,000 of persons living, there occurs annually in the country, and where the population to the square mile is but 199 persons, 19,300 deaths; but in towns and where the population to the square mile is 5108 persons, there occur 27,078 deaths. We find also that fever—the great disease of adolescence and manhood—the disease that most afflicts men and women at the most useful and valuable period of life—the great destroyer of mankind in

every climate—is bred and propagated in an especial manner in large towns; that towns present exactly in proportion as they are closely built and inhabited, the largest proportion of sickness and death from fever, not only as compared with the population, but with the total number of deaths from all causes. In purely rural English districts the mortality is found to be one in 54 persons annually; while in districts the most crowded with towns and cities, it rises to the deplorable amount of one in 36 persons annually. The fevers of the crowded quarters of London and of all the great towns is annually assuming a more formidable character, with an increase of its contagious virulence and power of propagating itself; its type everywhere indicating increased depression in the powers of life, as shown by the progressive lowering in the tone of the nervous and vascular systems.

6. In temperate climates, and in that of England especially, we have proof equally positive that scrofula, and consumption as one of its forms, are engendered to an extent second only in fatal result to fever; and if to the above we add the acute diseases of the lungs and air-passages, the diseases of the digestive organs, together with the gradual process of deterioration in the health of adults within crowded cities, and the actual destruction there of infant life, we shall arrive at some approach to accuracy in estimating the influence of crowding in producing disease and premature death in towns such as they are now arranged; in short, nothing can be more complete than the demonstration now afforded by statistical investigation as to the relative condition of the two great classes of the labouring or industrious population, the agricultural and the manufacturing; and of the fact also, that, where there is the greatest proportion of deaths, there too we shall find the greatest proportion of births. The agricultural class, though in a declining condition, is more near to what nature made it; the other presents us with a rapid succession of generations of stunted and debilitated families, reared up in moral and physical suffering;—precocious, improvident, reckless and intemperate;—more and more familiar with, more and more corrupted by, the cumulating uncleanness around them. It is proved that every class of disease, and almost every disease, is increased in towns beyond the measure of country districts. So much is this the case that the increase of deaths amongst children is fourfold by epidemics, and nearly ten-fold by convulsions in towns, as compared to rural districts. Amongst adults, again, the prevalent epidemic diseases are more than thrice as fatal in Liverpool and Manchester than in the country, while the deaths by diseases of the lungs are nearly doubled, the deaths by diseases of the nervous system as 5½ to 1, and by diseases of the digestive organs as 2½ to 1. All observation goes to demonstrate that the liability to consumption increases in an enormous ratio with the increase of crowding and its accompaniment, defective ventilation.

7. But the evils of crowding were everywhere of far greater extent in former times; and in times not very remote, the mortality in the British navy was 7·2 per cent. per annum, whereas it is now reduced to 1·6 per cent. It is not too much to say that the merit of taking decisive measures for the abatement of this and other injurious influences is due to the surgeons of our fleets and armies, wherein are now to be found the best and most extended examples of the benefits

to be derived from a regulated and supervised plan of sanatory regulation applied to masses. The value of the knowledge derived from the experience of the medical officers of the public services, has been practically though silently felt in every civil community, whether in Europe or America; but the merits of the authors have hardly in any instance, or at any time, been recognized in this country. This becomes the more obvious when the fact is borne in mind that, up to this day, there is not a principle in preventive medicine that has not been long since indicated in the writings of Pringle, Lind, Blane, Robert Jackson, Hennen, William Fergusson, James Johnson, Annesley, and others.

8. A consideration of all the circumstances observed during my recent tour to the populous cities and districts referred to in the previous sketches, as well as to the now amply recorded evidences of Mr. Chadwick, and of numerous observers, official and other, must lead to the conclusion, that though a certain amount of injury to the health of the labouring classes is attributable to sundry of their manufacturing occupations, and to the conditions under which these are carried on in certain large towns; still, that it is to the circumstances more or less immediately affecting the conditions of the private habitations of the poor that our chief attention ought in the first instance to be directed. Here we shall find the evils of defective ventilation—of the absence of drainage and sewerage, and of want of water—concentrated. Here—whether we regard the young or the old—the parents or the children—the evils afflicting the industrious poor, in their health and morals, will everywhere be found in their most aggravated forms; and they are so great, so extended, and so riveted by circumstances of habit, neglect, poverty, and bad law or regulation, as in my opinion, to leave no hope or prospect of diminishing them, without the interference of the legislature, supported by the active exertions of those intrusted with the execution of measures in the several districts.

9. The fact is now well ascertained, that, under those Governments that have taken active sanatory measures in respect to the condition of the manufacturing and labouring classes, these last are found to live long and well, as in the cotton factories near Vienna; while with us, too generally, and where the people have been left entirely to themselves, the result is lamentably otherwise:—the people have never been encouraged or instructed in anything—they have never even been told anything;—they have consequently done nothing. Such has been the practical result of the plan of leaving such enormous evils to correct and mend themselves; and such I believe it will ever be found. It is true that the dread of epidemic cholera, everywhere and for the moment stimulated the people, and the authorities in most of our towns, to vigorous plans of inquiry at least, as to matters supposed to be influential in promoting and keeping up the disease in particular, and epidemics in general. In many places, indeed, the most salutary preventive measures were sketched out for immediate adoption:—they were then, perhaps, considered in a cursory manner, and the instant cholera took its departure, those most excellent plans for the abatement of nuisances, and for the promotion of sanatory measures, disappeared along with it. Nothing was then done, nothing has been done since, and nothing will be done till it is so ordered, and till some responsible authority is placed to see that the thing is done. We everywhere find

people ready to declare, as in Derby, and in respect to every evil,—"There is not any law that could compel its removal, the place complained of being private property."

10. The most cursory survey even of the state of the dwellings of the labouring classes, in most of our large towns, must occasion feelings of painful regret that habitations should still be constructed in such a manner as to become the fruitful source of disease. The crowded state of many towns indicates the necessity of opening out courts and alleys, and of the adoption of some ventilating means for the relief of the dense masses of building.

But happily no harsh interference with the rights of property is here required. The interests of the builders and of the tenants, if only rightly understood, are identical; for, in this and in other matters, an honest intention, guided by a better intelligence, would serve both parties to generally good purpose. Under an improved condition of the dwellings of the lower orders, the tenant's ambition, hopes of advancement in life, and desire for increased comfort, would rise along with a laudable emulation;—there would be less of immorality and of disease—less drunkenness—more time and ability for labour, and more providence in the use of its earnings: in short, along with a general improvement in the entire condition of the manufacturing classes, there would arise,—all that the speculators in building desire,—an increased power on the part of the tenant to pay an increased rent.

11. The condition of the labouring man's dwelling may now be taken as an exact type of, and index to, his moral condition; the wretchedness of the one being indicative of laxity and depression in the other. But, if it be true that filth is more frequently an evidence of depravity than of destitution, it is equally true that both these last act and re-act upon each other, and have their origin in circumstances of position and of habit, arising very much from the now miserable state of the streets and habitations occupied by the working-classes. Let it not, therefore, be supposed that moral or physical uncleanness is characteristic of man in any stage of society, or even among the poorest in large towns: far otherwise is the fact.

On this subject it is gratifying to learn that "buildings can be erected, offering to their inmates the luxury of a decent, cleanly, and healthy abode, at a cost less than is usually given by them for the purchase of the squalid resting places they now resort to, and yet enough to repay a fair interest on the original expense of the new building." Such being the case (and all evidence goes to demonstrate its truth), there need be no hesitation in stimulating the efforts of the proprietors of such buildings by a little legislative coercion; while such as are better disposed, or more intelligent, will proceed in advance of the prompter, to what they perceive to be alike to their own advantage and that of the public.

12. In the matter under consideration, and indeed in all matters affecting the public health, no person, or body corporate, should be allowed to possess exclusive right in property so as to be rendered injurious to the neighbours; or at all events, so as to be used capriciously, and thus to cause injury to the health and morals of the community. The truth of these positions is readily enough admitted in theory, and as matter of speculation; but until we see them more vigorously and systematically acted upon and carried out, in a practical manner, in our

large cities and towns, but little good will be effected, in so far as regards the poorer classes of their inhabitants.

I am decidedly of opinion, therefore, that some measures should be adopted for regulating the masses of buildings, erected back to back, with regard to the courts and alleys, the cellar dwellings and the lodging-houses, to be found in such numbers everywhere throughout our towns. If these places are left to the casual or capricious amelioration of the humane even, amongst the proprietors, ages will pass away, and, with them, a rapid succession of miserable generations, the most destitute of their species, perishing from corroding want, ere the decay of the buildings gives room for arrangements suitable to the accommodation of human beings.

The grounds for interference would appear to be strengthened when it can be proved, as I believe to be the case, that the admission of an abundant supply of fresh air and good water will turn even to the advantage of the owners—that a humane course, even under constraint, will not injure their intetests, but quite the contrary :—indeed, it may be said with truth, that in respect to this, as well as to many other unsuspected sources of misery, disease, and death, amongst the poor, the causes are mostly easy and cheap of removal, and all of them readily capable of vast mitigation. It should, moreover, be continually in the minds of those in authority, that the removal of all these causes would cost less in money than does now the treatment of the diseases, and other miseries produced by them :—indeed, so far as my inquiries have extended, a vast public and private saving in money would be the certain ultimate result of every structural arrangement proposed here for the sanatory improvement of towns.

13. It has been calculated that the total number of orphan children, on account of whose destitution relief was given from the poor-rates in the year ending Lady-day, 1840, was 112,000. Of the parents of this number, we are confident that accurate investigation would demonstrate, full one-half died of preventable disease. The loss to the industrious classes consequent on sickness alone, has been variously estimated. One of the lowest calculations rates the number of days of sickness in the year, experienced by a man, his wife, and two children above 12 years of age, at 29 days, or about one-thirteenth of the entire year. Estimating the weekly earnings of such a family at 40*s*., we have here a great loss by labour alone, without medicine and other contingent expenses,—" But this is vastly below the mark, although quite enough to prove how truly economical it would be in every way to expend the same money upon airy, salubrious lodgings, conducive at once to health, morals, and respectability. In fact, there can be no doubt that the enormous sums spent every year in hospitals, infirmaries, and union workhouses, are incomparably greater than the expenditure necessary for preventing disease and pauperism." This I believe to be true and easy of proof: indeed, we have only to turn to the singularly valuable "Report" of Mr. Chadwick, to perceive as clearly as need be, how vast are the charges on account of sickness and mortality which are of easy prevention—how enormous the charges on the reduced duration of life —on the reduction by sickness of the periods of working ability or production—on the machineries for the suppression of much of the vice and crime which comes within the province of the police—as well as

for the relief of much of the destitution which comes within the province of the administrator's relief. According to the rate ascertained in eight Unions, Mr. Chadwick concludes that, in all the Unions, about 27,000 cases of premature widowhood occur, and more than 100,000 cases of orphanage—all which may be ascribed to removeable causes. Mr. Hawksley estimates the loss in Nottingham alone, "by the pressure of removeable causes of sickness and mortality at 300,000*l.* per annum." It is quite unnecessary to pursue this subject further. Innumerable details in proof are now before the public, and further description would but weaken the effect.

14. If it be the business of Government, to prevent and to punish crime—to secure the public peace—to enforce industry instead of rapine—and the settlement of disputes by appeal to reason instead of by fraud or violence;—if the well-being of the subject be, in short, the main object of legislation—then would it appear the special duty of the ruling power to secure the health and the life of those who, of all others, stand most in need of its protection against the invasions of individual or corporate caprice, ignorance, or stolid avarice. Here we perceive a moral and political duty of necessity. On this subject it should ever be borne in mind that, where there is disease, there also will be found the seat of poverty and crime. Disease, poverty, and crime in their worst forms are constantly and everywhere found together. The truth then is, that misery and crime produce disease, and disease produces misery and crime, in a circle which revolves in the same calamitous monotony from year to year, of the brief existence of the masses crowded in the worst quarters of our manufacturing cities.

15. Whilst men are in the lowest state of physical destitution, surrounded by filth, vermin, privation, and squalor of every conceivable kind—familiar with sickness and death, and strangers to every comfort—with the mind continually on the rack, or absorbed in striving against physical necessity—or with the animal spirits broken down by its pressure, how is it to be expected that obedience to the laws, and that morals, education, or religion, should find a place? How can a man whose mind is ruined even more effectually than his body—the man by whom moral degradation and physical suffering have done their worst,—how can such a man be expected to give a passing thought even to such matters? The thing is impossible. But not to speak of those higher considerations, I should say that the benefits of the surrounding civilization even are not for the occupants of the lanes, courts, and alleys, through which I have of late passed.

16. To assist in forming a correct estimate of the condition of the poor in manufacturing towns—of their state of moral and social disease—the quarters occupied by them should be visited on Sunday. The men absent on week days will then be found crowding the lanes and courts, some in sullen discontent, and others seeking in the excitement of spirit-drinking, to get through a day that passes heavily over all. In speaking to these men, I have very generally been told by them that the great majority betake themselves to such modes of spending Sunday through want of decent clothing, the only suit in their possession being that in which they labour throughout the week. It is only by experience that the inquirer, after the causes that injure public health, becomes familiar with that remarkable apathy which so calmly submits to

the greatest ills; otherwise the utmost astonishment would arise, from the spectacle of entire masses of people crouching under such aggravated misfortunes in the quiet manner we everywhere observe.

17. And yet, let it not be supposed that the information here spoken of is a matter of abstruse science, difficult of attainment, or, least of all, that towns are necessarily unhealthy, any more than barracks or ships. Indeed, prisons which, in times not very remote, were pestiferous, are now in a state far more favourable to health than the districts surrounding them; and this amelioration, observable all over England and Scotland, has been brought about by means intelligible to any sensible or observant person. I believe that the highest attainable salubrity may be secured to cities and towns by attention to matters that, with us, have been very much neglected; that by a proper construction of habitations, a proper ventilation, sewerage, supply of water, and the daily removal of refuse of every kind by scavengers, a town population may become quite as healthy as that of the country.

The neglect again of these simple measures will cause disease, and is daily producing disease of the worst kind, even in cottages and other detached buildings, placed in the most favoured positions by nature. It is both interesting and important to observe how often the best and the worst of natural states of locality are altered, the one to our prejudice, while the other is turned to our advantage, by the neglect of, or by attention to, the very simple measures of prevention above named. For instance, I have seen in various of our cities, but nowhere more conspicuously than in Norwich, that the very best portion of the site of the town, both as to quality of soil and rapidity of fall, was rendered pestilential by the neglect of structural arrangements, while with attention to these last, the very worst portions, the flat and marshy lands, and the clayey sites, were rendered comparatively salubrious; and thus it will be found all over the world. It is the same on the banks of the majestic Ganges, and on those of the barely navigable Yare.

18. What is socially true of London, is so in great part of all the provincial towns; the occupants of the better quarters, with a few individual exceptions only, know absolutely nothing of the state of the worst quarters. Owing to the vastness of London—owing to the moral gulf which there separates the various classes of its inhabitants—its several quarters may be designated as assemblages of towns rather than as one city; and so it is, in a social sense, and on a smaller scale, in other towns; the rich know nothing of the poor;—the mass of misery that festers beneath the affluence of London and of the great towns, is not known to their wealthy occupants. This arises, not from want of kindly feeling or charity towards the poor; far from it, but from the absence of such institutions as should call the attention of the higher and of the wealthy classes to this subject. Had boards of health, properly constituted, existed in this country, the public mind, through their endeavours, and through other means of information, would long since have been well informed on matters regarding which it is now utterly and lamentably ignorant.

19. The absence everywhere of a sufficient local authority, and of proper regulation in matters affecting public health, cannot fail of attracting the notice of the most inattentive observer. This indeed is now, and has always been, one of the most serious wants in our cities

and populous districts. Bodies having the name of authority, but really wanting in power, are everywhere to be found. They are elected also in a popular and acknowledged manner, but nowhere can we find either efficiency or responsibility.

It follows naturally from this state of things, that self-interest, hasty popular impressions, prejudices, and ignorance, are too often made to actuate the movements of a body having already the disadvantage of being fluctuating; and that in a situation where, of all others, we require intelligence, unity of action, permanence, and a binding responsibility. Wherever I made inquiry as to the authority or the arrangement for carrying out measures of sanatory import, I was answered, as in Norwich, "This court has seldom or never sat."

20. On examining the Local Acts, it will be found that, in a large majority of instances, they are mostly inoperative, owing partly to intrinsic defects, and partly to the character which, as above stated, must belong to the body now administering the law, such as it is. It would appear therefore that, in place of the present costly and defective system of local law and local administration, we should have improved laws and competent and responsible persons to see them carried out, and to superintend the health concerns of all towns and populous districts,—persons of proved capacity, and altogether independent of, and unconnected with, local influences. Of the absolute necessity of independence of local influence and authority, on the part of Health Officers, we have an emphatic example in Norwich. After describing a public nuisance, Mr. Johnson candidly states as follows:—"I am acquainted with many more; but it is obviously improper to make any direct reference." It is quite clear then, that any supervision, to be useful, must be altogether free from, and irrespective of, local influence.

21. I have everywhere found the powers conferred by the Local Acts complained of, on the score of their insufficiencies and defects. This is especially the case, strange to say, with those of more modern date, which, at the same time they are minute in details, exhibit a total and complete unacquaintance with the subject, as relating to public health; sometimes enjoining what is wrong, and at other times prohibiting what is right, while in no two cities or towns do the principles or the details of the Act accord with one another. It is different with the ancient Acts; they enter little into details, satisfied with simple injunctions on the main grievances, and leaving the rest to the local authorities.

22. As an example of bad law, I would instance that which goes to exclude light, and with it air, by causing the blocking up of windows which, if opened, would be taxed. A good law, on the other hand, would prescribe that in all places constructed to receive numbers of persons especially, as in factories and great work-shops, a sufficient ventilation should be secured; and such ought to be made imperative by law in every instance.

23. To exhibit again, the loss of time, as well as the difficulty of getting men to act, even in the way most directly conductive to their own interests, I would instance the enactments for the prevention of fires. The advantages derivable from party-walls must at all times have been apparent to the owner, the tenant, and the insurer; yet, nothing was done by either, until the legislature stepped in; and now, the most pre-

cise regulations are cheerfully complied with on all hands. "It is always found," says the Leicester Report, "that the inhabitants submit with less readiness to a law imposed upon them by their fellow-townsmen than to one coming into operation under the authority of the legislature."

24. A consideration of the history of public health in this country will satisfy any one that, not to the defective nature of the laws, (insufficient as these are to the supply of modern wants,) but to the defective execution of them must, in a great measure, be referred the neglected state of our towns and cities. Our laws are as old as Edward I., but in modern times certainly, the very recollection of them has been lost; and thus, though the first to legislate in affairs relating to health, we have fallen behind many of our neighbours in actual practice. That a better order in administering the laws, such as they are, would have secured the inhabitants of the worst localities from much suffering, and from many grievous nuisances, there can be no reason to doubt, but the very administrative system now in operation is in itself jostling, unscientific, jarring, cumbrous, and costly; while, in respect to the public welfare, in matters of health, it is feeble, vexatious, and ineffective. The truth is, that the very nature of the bodies that supervise the improvement of towns, as to sewerage, the supply of water, and of light, the removal of town refuse, &c. &c., is as little known to the rest of the community as that of the powers of darkness. The national importance of the subject demands that this state of things be no longer continued, and that a better informed, a better regulated, and a more simple and responsible plan of supervision and control be at once established in all the cities and towns of the empire; for, as has been well observed, it is only when the public health is made a matter of public care by a responsible public agency, that what is understood can be expected to be generally and effectually applied for the public protection.

From what has occurred in England in reference to this subject, as well as from an intimate acquaintance with the practical working of the several systems, adopted from time to time for supervising the health concerns of our armies, both at home and abroad, I feel satisfied that no laws, however excellent in themselves, can ever prove of sanatory avail without an impartial, independent, and systematic plan of supervision and control, and that through competent and responsible individuals in each town; persons altogether unconnected with local influences, and being themselves regularly supervised, and held responsible to other remote and higher authority. Parliament, which constitutes and grants powers to public bodies, has also the exclusive right to establish a power of watch and control over them; and thus alone can the evils arising from local prejudices, ignorance, mismanagement of health, and waste of the public money, be prevented. Medical police, in short, must be made a matter of statutory ordinance, a fixed and settled institution, to prove of the least use to public health. It is thus alone that the health of a community, whether civil or military, can ever be properly looked to; and I will venture to say that all who have considered the matter with care guided by experience, will agree with me in this conclusion. The subject is one of the last importance.

25. The duty of professional superintendence in sanatory matters is, for obvious reasons, even more necessary in civil than in military com-

munities, and should not be confined to cities and towns, but ought to extend as well to the agricultural districts, in which the neglect of drainage and other preventive measures, around the cottages of the poor, are found to be sources of much disease and suffering. This duty, well performed, would soon inform the people besides, that drainage not only improves the climate, and health in consequence, but renders the soil itself doubly valuable and profitable.

26. A Board of Health, wherever appointed, should be composed of engineers, architects, and persons of other callings, but who are conversant with matters of sanatory import, with one or two medical officers. Medical men in all times and countries have naturally been in advance of the public in appreciating the causes, and in discovering the most decisive means for obviating disease; and it is to their exertions, in the public service especially, that the application of the means of amelioration and of prevention, on the most extensive scale, must alone be attributed. The medical officers of our fleets and armies have the advantage of being informed of the whole circumstances of the organized bodies of men under their observation, and often see these circumstances suddenly altered, or have even the power of altering them at pleasure. These are great advantages, and they are obtained, so far as health is concerned, without interfering with any man's comforts, rights, or privileges. The benefits of the information and experience thus obtained in the public services, have never been exclusively confined to the fleets and armies of England, but have extended freely to the condition of the civil community, so far as it was in the power of medical officers to do so, by frequent appeals to authority, to the public, and by the supply of the most valuable statistical, and other published information. In the judicious selection of medical men, from whatever class of society derived, we shall therefore find the best guarantee for the effectual carrying out of measures of an enlightened policy. But were there no other value in such an officer than the being the channel of communication with, and of instruction to, the working classes, on matters affecting their health, his labour would be inestimable.

27. But with all these advantages, it is by no means here intended to claim exclusive preference for medical men; for even they require special study and experience to qualify themselves for the task,—the duties requiring as much both of special study and experience as any branch or department of medicine. As Duchatelet justly observes,—a man may have exhausted medical literature—he may be an excellent practical physician—an eloquent and clever professor; but all these acquirements taken in themselves are nearly useless in a Conseil de Salubrité, like that of Paris.

To be useful in such a Board, a man must possess an intimate knowledge of the habits of large communities, and of their various moral and physical influences; he must know the nature and condition of the soil and locality—guided by an extensive acquaintance with natural philosophy. These and many other things he must know as it were by habit; and I repeat that they are not, in our day at least, to be acquired from books.

28. From all that I have seen and read, as well as from the overwhelming evidence on the subject now before the public, I am led to

submit to the Commission the propriety of recommending legislative measures in respect to the condition of the habitations of the poor, not only prospectively but retrospectively also. As justly observed by Dr. Southwood Smith,—"Every reason which has placed the construction of the dwelling houses of the better classes under legislative regulations, or which can be suggested to show the justice and necessity of legislative interference in this matter for the well-being of the public, apply with tenfold force to the dwelling houses of the poor."

29. The legislature has already sanctioned and acted on the principle of interference in the dwelling houses, in respect to their strength, and the measures necessary for the prevention of fires. I cannot suppose that it will here stop short, or that measures of far more urgent necessity in respect to health, morals, and comfort, will any longer be deferred, or allowed to remain in abeyance. The poor would receive this interference as a blessing. All evidence goes to prove this. In any provision that may be made by the legislature for the regulation of buildings, it will be necessary to provide for the ventilation and warming of all buildings made to accommodate masses, whether hospitals, asylums, schools, or workhouses.

30. To carry out effectively the necessary measures of sanatory regulation for the habitations of the poor, it seems necessary that all the greater class of rates should be levied on the proprietors, such as the sewers and water-rates. It will greatly tend to ensure cleanliness and order; and the benefits derivable from such regulation would be felt not only in the private habitations of the working classes, but in those pest-houses so common in all our cities—the lodging-houses. The manner of street and house-cleansing is also very defective; and the law which limits the power of abating nuisances to highways and thoroughfares should at once be enlarged and extended. It is surprising that authority to interfere in such matters should be altogether wanting in the very quarters where of all others it is most required—in the courts, lanes, and alleys; but such we find it everywhere. The accumulation of refuse matter within houses, for instance, is greatly more injurious to health than the same condition under exposure to sun and wind, bad as this latter must be; and such private nuisances ought therefore to be even more effectually guarded against. This branch of preventive police, conducive alike to morals and health, ought to be strictly and systematically regulated and administered in all our towns and cities.

31. Ventilation being second in importance to no other question affecting public health, demands, and I hope will soon receive, the separate and careful consideration of the legislature. Pure air is so necessary to life, health, and comfort—more necessary indeed than food itself, inasmuch as that, without a due supply of it, the best and most abundant food will give neither health nor strength,—that to ensure it in every house occupied by the poor—in every factory, workhouse, hospital, or other building made to receive numbers—seems a primary and imperative duty. When we reflect on the amount of suffering and death produced in former times in ships, barracks, hospitals and prisons, by bad ventilation mainly, and on the sad effects now daily observed in the courts, lanes, alleys, cellars, and masses of buildings

erected back to back, everywhere to be found in our great towns, we shall perceive how necessary it is to adopt decisive and immediate steps for the removal of this enormous and pervading evil.

Happily we are now in possession of means whereby not only an abundant supply of fresh air, but of warm air also, may be furnished for the use of the poor, at a vast saving in the expenditure of fuel. This, as observed by Dr. Southwood Smith, is a piece of knowledge capable of effecting a greater change for the better in the condition of the working population, perhaps, than any other single improvement whatever, because there is no other at all comparable to it in importance capable of so general an application at so small a cost. Subserviently to freedom of ventilation, and to the admission of light, I would call attention to the complaints brought under my notice, that the existing laws relating to the window-tax have operated most injuriously by causing passages, cellars, privies, closets, and roofs—the very places requiring ventilation, to be very generally without windows. It appears that when the law of the 4th and 5th William IV. gave freedom for the construction of windows, the sanction was very extensively used to the great satisfaction, comfort, and health of the inhabitants of cities and towns; but that, when upon an unexpected legal interpretation, all the windows thus opened out were rendered liable to taxation, they were very generally closed up, to the vexation and injury of the poor especially. Mr. Hickson asserts, that by an alteration in the law, which, instead of the present scale, increasing at an average rate of 8*s.* 3*d.* for every window beyond eight, should assess upon the principle that every house built requires for light and air a certain number of openings in proportion to its cubic contents, and that these openings be paid for, whether they exist or not, would prove a great benefit. This would at once remove every temptation to defective construction; and after a house has been once assessed, Mr. Hickson thinks that the proprietor should be at liberty to make as many additional openings as he pleases. Thus, he considers, a great practical improvement may be brought about by a few simple causes, and without any loss of revenue. Mr. Hickson, in conclusion, asserts, that after a long and mature consideration, he is convinced that his proposed alteration would, without the loss of a shilling to the state, confer a greater blessing upon the middle and working classes, as regards their habitations, than it is possible to obtain in any other way, or in so cheap a manner. Other means of ameliorating their condition may require local taxes or public grants, but here a great practical improvement may be effected by the stroke of the pen. Amongst the many evils resulting from defective ventilation, there is one with which the public is little acquainted, viz., its powerful tendency to counteract and oppose all the benefits derivable from medical management. But this is a truth without an exception; and while such is the effect on the sickly, we find the same deleterious influence driving the healthy to the use of stimulating and intoxicating drinks, in order to overcome the nervous depression occasioned by respiring impure air.

32. It is quite indispensable on every account that supplies of pure water for ablution, house-cleansing, and sewerage should be at the disposal of the working classes; for in this matter an injudicious economy affects the morals, habits of manliness, comfort, and health of the poorer classes, most injuriously. An abundant and constant supply of good

water will conduce more than any injunction, or other means, to foster a disposition and to create a habit of personal cleanliness, and thus lead to habits of decency and moral purity, beyond what might at first sight be deemed possible from such simple means.

The water should everywhere, and in all tenements, even those of the poorest, be supplied separately to each house, and be kept on at high pressure; this is quite as easy as it is necessary to public comfort, and to the security of property, in cases of fire.

"No previous investigation," says Mr. Chadwick, "has led me to conceive the great extent to which the labouring classes are subjected to privations, not only of water for the purpose of ablution, house-cleansing, and sewerage, but of wholesome water for drinking and culinary purposes." This is quite true; and such is the amount of injury, moral and physical, produced and kept up, by this very deprivation of an element—as indispensable for many purposes of life as the air itself —that no amount of amelioration in other matters, but which should leave this evil untouched, could avail for the benefit of the poor. Conveniencies in supply of water must precede the formation of habits amongst the poor; indeed, we shall derive a very material aid towards a just comparison of the habits of different people, or of the inhabitants of different cities, by a knowledge of their relative supplies of water. It is an observation as old as Hippocrates, that—"it is necessary for a physician, when entering a city of which he knows nothing, to examine its exposure, the predominant winds, the seasons, the nature and elevation of the soil, the quality of the water of which the inhabitants make use, and the kind of life they follow."

There are many and grave objections to the present mode of supplying water to towns by private companies, such as their being arbitrary, irresponsible, and unaccommodating. They have also a strong interest against all improvements in the quality or the quantity of water, as engendering expense and diminishing profits; besides it is not a mode available for the inhabitants of rural districts or of small towns. Professor Clark, of Aberdeen, Mr. Hawksley, of Nottingham, and Mr. Thom, of Greenock, have offered their very conclusive evidence against joint-stock companies, as compared to the town management; and they are equally agreed that no town can be considered as duly supplied unless the service is constant, that is, unless the pipes are kept constantly full, as in Nottingham under the able superintendence of Mr. Hawksley. Aberdeen, with a population of 70,000 inhabitants, is supplied by the Commissioners of Police, who are elected by the ratepayers. "The establishment of a joint-stock company," says Professor Clark, "for the supply of a town with water, is establishing a monopoly of trading persons, having the power, without responsibility, of taxing the inhabitants for their own benefit." The profits in Aberdeen go to the revenue of the town, and nowhere else has the Professor seen any city in all respects so well supplied with water.

Water according to the evidence of Mr. Holme, of Liverpool, might have been supplied to that city, through the municipal authorities, "at one-sixth of the present price; or, if we had paid the same price, a large disposable revenue would have accrued to the public local exchequer, which would have diminished our taxation, or have enabled the authorities to have established public fountains, and had public reservoirs for the use of the poor in every locality." The competitions, too, as hitherto carried on, are wasteful in themselves, and burthensome on the public—three sets of water-pipes belonging to three companies being sometimes found in London to pass through one street, and three enormous capitals sunk in the supply of one district, for which one capital and one establishment ought to suffice. In truth, what are commonly taken to be competitions in which the public interests are believed to be gainers, are in reality, and almost without exception, combinations against the public interests. It is thus with the water and the gas companies. The so-called rival companies sooner or later coalesce; they agree upon and determined the rates at which they will allow the public the necessary supplies of water and gas. Every new company that starts is soon found to merge in the old; and thus, in place of one original company or management, we have commingled twenty companies with twenty managements—the public paying the difference.

33. Of all structural matters external to the habitations of the poor, sewerage is the most important; and with a proper attention to this latter, along with the internal requisites of fresh air and pure water, there would remain little else to repair which depends on authority. The evidence exhibiting the calamities attending on the absence and defect of sewerage, as well as that showing the advantages to health resulting from a complete system of underground removal of refuse, is so complete and so familiar now to the public, that nothing need be said in addition. Preparatory, however, to the enactments necessary towards a general and efficient system of sewerage, it will be necessary to require that every city and town be furnished with a complete and proved plan of levels. The absence of this simple measure, so necessary in itself and easy of reference, has caused endless confusion, loss, and disappointment. This preliminary step secured, there can be no difficulty in framing such regulations as shall enforce and ensure not only that house refuse but street refuse also, shall be regularly and speedily carried off by properly constructed sewers. There is now no plan, no order, nothing like a law of uniform operation; the consequence is, that sewers are everywhere complained of as defective in number or plan, or both; and nothing can ever secure a proper construction, fall, and supply of water for the purposes of flushing but a comprehensive and stringent legislative ordinance applicable to all crowded localities, and placed under the supervision of authorised and responsible persons. The custom now prevalent in many towns, of leaving courts, lanes, and alleys to be cleansed by the inhabitants, is highly objectionable. The duty is either neglected or most negligently performed. The truth is that this, like other matters of police, can only be effectually done through the agency of responsible persons regularly trained and paid.

34. In respect to these cardinal points, as regards public health in towns—a proper construction of habitations, including systematic ventilation—sewerage—scavengering—and a plentiful supply of pure water—the poorer classes are utterly without help. They can do nothing for themselves. And let it not be supposed that measures of amelioration in these respects would be viewed by them as unnecessary or vexatious interferences: all evidence goes to establish the contrary;

and I am satisfied that whatever legislative measures may be adopted will be received by them with the utmost gratitude, and as a real boon. In respect to the poorer classes, there is, as already observed, but one moving power—the legislature of the country—the prescriptive guardian of the public welfare; and I am thoroughly satisfied of the proper sense, on the part of the poor, of benefits conferred.

35. The same gratitude will be felt in respect to the adoption of proper measures with the burial-places in our cities and populous towns, which are now becoming dangerous and profane—moral and physical pestilences of the first magnitude; places, the sight and contemplation of which should cherish veneration, and all those tender feelings that connect Christians with the dead, but which in reality shock the feelings and offend the senses; exhibiting scenes at once loathsome and appalling. The evils, moral as well as physical, connected with this subject, are now so well known, and have been so ably set forth by Mr. Chadwick, that it is hardly necessary to do more than draw attention to their existence.

36. In no town that I have visited, or that I have heard of, does there exist any public survey conprising the levels, whether local or general. It results from the absence of such preliminary requisite that structural arrangements of every kind, as to houses, the laying on of water and gas, the arrangement of streets, drains, and sewers, are conducted at random, without combined plan or uniformity, the operations going on in one quarter of a town having no reference whatever to such as may be in progress in other quarters; and thus, in place of a simple, uniform, and comprehensive system, confusion, inconvenience, and loss of money, both public and private, arise. On this head the call for the aid of the legislature is general. The evidence of Mr. Holme, of Liverpool, and of Mr. Hawksley of Nottingham, and of others, goes directly to this object. Besides plans of levels on a large scale, every town should be provided with geological charts, comprising the geology of the site of the town, as well as of the country around. Good maps of towns on a sufficient scale are also much wanted.

I cannot too emphatically urge the utility, and, indeed, the necessity of constructing such plans, or the great public benefits to be derived from rendering the public mind familiar with the map. Nay, there ought to be in every borough and city a topographic and statistical report, carefully prepared, and printed at the town cost, to which the more intelligent inhabitants should have free access. The more this is done, and the more communities are made acquainted with the reason of the thing, and thus made parties, as far as practicable, to the improvement of towns, the more will it conduce to the benefit of communities, local and general. Had such simple means been in common use in our towns, a thousand expensive mistakes had been avoided.

37. Though no scheme of practical application has yet been propounded for the conservation of town refuse, and for preserving rivers, as the Thames for instance, from the contamination of sewers, yet, from the evidence of all the engineers, and the general interest expressed by numerous intelligent persons, that something of this nature should be devised, I have no doubt that sooner or later some general system, having reference to the above important objects, will be framed and

adopted in our cities and towns, and so as amply to repay the cost of any means that might be used to bring the refuse matter to a situation convenient for disposal.

The evidence of Dr. Southwood Smith on this subject, like all that comes from such an authority, is deserving of great attention. He regards such means as affording a well-grounded hope that every town and village in the kingdom may be put in a good sanatory condition, by the removal of the grievous physical evils which at present oppress them, and especially the poorer parts of them. Dr. Southwood Smith "has been unable to detect any fallacy" in the evidence on this head, and considers that the means of removing so great an evil "are within our reach."

"When, for example, it is stated that refuse to the value of nearly double what is now paid for the water of the metropolis is thrown away, partly from the drains which are discharged into the Thames, and partly from the private drains which are not carried into sewers at all, it is clear that the prevention of the disease, suffering, and death, which has been shown to oppress such large classes of our population, is quite practicable; and that if measures are not taken to stop these dreadful evils, it is owing not to any insuperable difficulty in the subject, but to our own apathy and indifference." To the question whether, under proper regulations, it would be found practicable to make the very refuse removed go far towards defraying the expense of constructing and managing the drains and sewers by which it is removed, Dr. Southwood Smith replies:—"Yes; and I think there is a reason for this expectation, which has a deeper foundation than is apparent on a superficial view of the subject. There are certain adjustments established between the physical and the organic kingdoms, and between the two great divisions of the organic kingdom, which we should do well to bear in mind even in the most practical consideration of this matter. We know that atmospheric air is equally necessary to the life of plants and animals, but that they produce directly opposite changes in the chemical constitution of the air: the plant giving off as excrementitious that principle of the air on which the animal subsists, and living upon that part of it which the animal rejects as excrementitious; while the animal, in its turn, restores to the air the principle which constitutes the food of the plant, and subsists on that which the plant has rejected as no longer useful to it. In this manner these two great classes of organized beings renovate the air for each other, and everlastingly maintain it in a state of purity and richness. On this beautiful adjustment depends this further principle equally as the foundation of all rational and efficient sanatory regulations—namely, that the very refuse of the materials which have served as food and clothing to the inhabitants of the crowded city, and which is allowed to accumulate there, invariably and inevitably taint the air and render it pestilential—promptly removed and spread out on the surface of the surrounding country, not only gives it healthfulness, but clothes it with verdure, and endues it with inexhaustible fertility. These are the great laws of nature, which are now well known to us; a due conformity with which would bring us health, plenty, and happiness, but which we cannot disregard any more than we can disregard any other physical law, without suffering, and perhaps destruction." In conclusion, I would observe that this subject has not yet received, and I fear will not for some time, receive the attention from the public that is due to its importance.

38. It might savour of caricature were it asserted that, in respect to the labouring poor, it is only when the infant enters upon breathing existence, and when the man has ceased to breathe—at the moment of birth, and at the hour of death—that he is really well washed; yet such a statement would not be so far removed from truth as may at first appear. To the great mass of the people, and from the dawn to the term of life, the bath, as an article of comfort, luxury, and health, is hardly known, even in name. Without entering into a professional disquisition on the functions of the skin, or on their vast importance to health, or on the necessity of attention to them, and to the purity of the surface of the body, I would observe generally, that to the neglect of all these is due the prevalence of very formidable diseases, by no means confined to the skin itself. When we consider the nature of the labouring man's varied occupation, and the violence of the alternate actions of his lungs and skin, during many of his most active operations, we shall at once perceive how much more he stands in need of the attention here urged upon public notice than the man in better circumstances, and who is not thus exposed either to the violence of functional excitement, or to the extremes of atmospheric changes. Dr. Coombe's remark is perfectly just, that "if one-tenth of the persevering attention and labour bestowed to so much purpose in rubbing down and currying horses were bestowed by the human race in keeping themselves in good condition, and a little more attention were paid to diet and clothing, cold nervous diseases, and stomach complaints would cease to form so large an item in the catalogue of human miseries."

But the advantages of personal cleanliness are not limited to their mere physical effects; the sensations connected with cleanly habits being justly observed by Sir Gilbert Blane to constitute some of the most precious gifts of civilization. "A taste for them tends to give a distaste to degrading and grovelling gratifications; and the common saying that 'cleanliness is next to godliness' is founded on reason, inasmuch as it is conducive to moral purity as well as health and pleasure." With the knowledge of all these facts and circumstances, it is lamentable to think that, to the working classes inhabiting our great cities and towns, personal cleanliness is at present impossible.

39. The observations of lay persons on questions affecting public health are of great importance; indeed, the experience of observant laymen has not been sufficiently regarded by professional inquirers. But admitting its importance, there are yet some circumstances connected with lay evidence requiring that we should sometimes receive it with reserve. One of these drawbacks consists in the impression so common amongst citizens, that *their* city or town forms an exception to the rule of unhealthiness; indeed, they receive any intimation to the contrary as an impeachment (*stigma* is the term they use) of the character, moral as well as physical, of their favourite locality; and so strong is this feeling, that men of the highest integrity and intelligence will be found continually to deceive themselves, and, unintentionally, they will endeavour to deceive others on such points. To such a degree has this feeling arisen in some towns which I could name, that the immigrations

of labourers from neighbouring towns are adduced as causes of increased mortality, in utter forgetfulness that such immigration necessarily implies an accession of youth and manhood, health and vigour—conditions which, for obvious reasons, go to reduce the mortality of a town. On other occasions, we find them charge the burthen upon the various institutions for the supply of food and clothing, workhouses, hospitals, and dispensaries, receiving only natives and residents of the town;—institutions the daily operation of which tend to prevent the spread of disease and mortality, have been cited as the occasions of disease and death. Even the proofs to be derived from statistical record are frequently not sufficient to satisfy the prejudices of such well-meaning persons; and it is curious to observe how very similar is the feeling here described with that of residents in some of the worst known climates. The man who has been so fortunate as to live out 30 years in Jamaica cannot be made to understand how it is that Europeans on an average die there at the rate of 152 per 1000, or more than one-seventh of the entire number annually; and the inhabitants of Sierra Leone, where the average annual mortality amongst British troops is 483 per 1000, or nearly one half, will warn the stranger against a residence, however short, in the Gambia. "You may live," say they, "long and well with us at Sierra Leone; but if you go to the Gambia you are sure to die." In some years, as in 1825-26, 726 and 783 per 1000 respectively perished within the year at Sierra Leone; but "the climate in every instance is exempted from the supposition of being in anywise connected with the event." The delusions in both the foreign and domestic instances are the same:—they only differ in degree.

But laxity and want of accurate observation is not exclusively confined to the lay community; for sometimes we have an exordium of the following character from quarters whence a more exact information might be expected:—"This town I consider, upon the whole, one of the healthiest towns in the kingdom." Again, of another town like the last most unhealthy, we have it reported, that "the general condition of the town is comparatively healthy: at the present time it may be considered in a very healthy state."

It is but justice to state, however, that, in general, throughout the entire extent of my personal examination, I found the medical witnesses alike intelligent and humane.

40. The most cursory reference to the condition and habits of life of the working classes must satisfy any person of the immense advantages, moral and physical, that must accrue to the inhabitants of closely-built towns by the establishment of public parks, play-grounds for children, and gardens, like that presented to the town of Derby by Mr. Joseph Strutt—a noble gift, and a most noble example; but one which few persons have the means of imitating. The necessity, however, of some general measure on this head seems now to be very generally received and impressed upon the public mind, for, without such provision, we should soon, though the rapid increase of towns, behold masses of the labouring people reared from infancy to mature age without once breathing in an open space, or once enjoying the refreshment to be derived from exercise in the green fields—an unnatural and cruel position, but a state that even now holds true of great numbers in all our large cities. Whoever would desire a practical illustration of the necessity,

on moral grounds, of the recreative measure here urged, need only to visit, on Sunday, any of the lanes, courts, and alleys of every large town, and they will there find quite enough of the scenes already described, as well as the "bartering of fowls and dogs, and so on," not to speak of juvenile depravation and delinquency, to be assured of the necessity of presenting to the labouring classes some inducement to other and better pastime.

41. The complicated injuries caused by the Lammas tenures in Nottingham, Coventry, and indeed in every town that is affected by them, are such as to demand serious legislative interference. A privilege, declared to be "in itself nearly valueless," but which, in its operation, gives rise to such dens of misery as the lanes, courts, and alleys of Nottingham—that opposes a barrier to the just extension of a town in any direction—demands a serious re-consideration, with a view to remove the sad abuses arising out of it.

The manner in which this great evil has been sanctioned from generation to generation would of itself afford sufficient example of the neglect and inefficiency of the existing system in sanatory affairs. Here has been an evil of the first magnitude staring the authorities in the face for ages; and yet, so far as I know, or have heard, no one individual has ever made any effort or appeal against it: on the contrary, I have heard of many stout resolutions to resist every attempt at a just or useful disposal of these lands.

But whatever plan is adopted, and whatever measures may be taken with these grounds, there can be no doubt that, with due regard to existing rights, the throwing them open, and the giving access to them for building accommodation, for parks and exercising-grounds, would go far—perhaps further than any single measure besides—towards emptying the courts, lanes, and alleys of such towns as Nottingham and Coventry. By such a measure the poor would be led to believe that their condition is considered with a kindly interest by the legislature; and in every sense, moral and physical, such a measure would produce the best effects.

42. I have said nothing directly on the influence of morals on health —a large and pervading subject—on which, however, it is proper to touch, because it is proved by every day's experience, that, in the large majority of instances, immorality and its consequent diseases are but the results of physical destitution or depression. How commonly do we find that the deep and protracted distress of mind which necessarily accompanies aggravated states of bodily suffering, produces that diseased action and re-action—that riciprocal moral and physical disturbance—which, sooner or later, destroys the balance of health. It is this double action that is tearing up the nervous system of the operatives—that system which, from its highly endowed sensibility, receives the first impress of every morbific cause, whether acting primarily on the mind or the body. The more impressible character of the nervous system in females, rendered less apparent by the passive fortitude of their nature, and by their greater power of endurance, comparatively, brings upon mothers, and through them upon their offspring, a mass of suffering greater even than that which afflicts the more complainant father.

I am here stating important circumstances that have come largely under my observation. I have no desire to excite useless sympathy.

It is proved that, by lowering the power of the nervous system, the mind is broken down even more rapidly than the body. It is proved that so long as the physical powers are depraved and depressed, there can be no hope of moral improvement; and these facts, open to the observation of all, ought to be sufficient. There is one other general observation I would here offer on a subject bearing powerfully upon the question in hand, but regarding which the public at large is possessed of hardly any information: I refer to the great influence of diet on the moral no less than the physical condition of the working classes.

That an ill state of the general habit—a deterioration of all the functions of the body—and a susceptibility to the impression of contagion, as well as all the other exciting causes of disease—are induced by a scant, or by an exclusively vegetable diet, may be known to many. But what I would here especially call to notice is, that the moral habits of action and thought, the sentiments, and character, are seriously involved in the present system, and in the question of diet; and that it never yet has happened that men living in the manner of our town population, and reared almost exclusively on vegetable food, have been other than depraved in mind; irregular and vicious in imagination, in proportion to the reduction of the physical powers; irresolute; and incapable of defending themselves from insult or oppression.

The history of certain countries, and of different religious orders, is demonstrative in proof; and I fear the evidence may now be found in various of our cities and districts in England, so as to give to this question a national importance: indeed, we need go no further than the statement of Sir James M'Grigor, to the effect that, "of men reared in large towns, about 47 per cent." of the army recruits are "medically rejected."*

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* The following questions were submitted by Mr. J. R. Martin, for the consideration and reply of Sir James M'Grigor, the Director-General of the Army Medical Department:—

1st. Referring to your experience, have you observed any marked differences, and what, in the physical and moral qualities of recruits enlisted in towns as compared to such as enlisted in the agricultural districts?

2nd. Are there any differences observed, or reported upon, as to the moral character and physical capability for foreign service of the two classes?

3rd. Have any observations or reports been made on the relative duration of service of the two classes—the townsmen and the agriculturists?

4th. What proportions per cent. out of the two classes referred to, and received as recruits by the recruiting-serjeants, are rejected as unfit for military service?

5th. Of the two classes, townsmen and countrymen, what proportion per cent. of each attain to forty years of age in the army?

Replies of Sir James M'Grigor.

MY DEAR SIR, Army Medical Department, 22nd December, 1843.

With reference to your letter of the 10th instant, containing certain queries concerning the comparative merits of the recruits raised for the army in towns and in the agricultural districts, I beg to state in reply:—

1st. That it is a matter of every day experience that the physical and moral qualities of the country recruits are of a much higher order than are met with in men who have been reared in large towns.

In the former, the bodily and constitutional powers are in general much greater than in the latter. There is much less proneness to disease in countrymen, while the power of withstanding the inroads of sickness is in them considerably greater; and

In conclusion, I would state my conviction, formed on the experience acquired in my recent as well as previous investigations, that the health of the population is materially lowered, and the duration of life, especially among the poorer classes, shortened, by the existence of the numerous and complicated evils now found to prevail in all large towns. The result of my inquiry confirms me in the opinion so frequently expressed by persons with whom I have been in communication in the several districts, that such causes are, many of them, capable of removal under the existing laws, but that an effectual and complete remedy can only be applied by an alteration and amendment of the laws.

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they are far more capable of enduring the fatigues and privations to which soldiers may be subjected than recruits of the latter class—in whom the stamina have been at best but imperfectly developed, and whose general health has been depreciated by the nature of their occupations and habits—impure air, want of proper exercise, and the many debilitating and morbific influences inseparably connected with the condition of artisans in large towns.

2nd. For these and similar reasons, there exists a marked superiority, both physically and morally, in the capabilities for foreign service of the country recruits over those possessed by townsmen; in proof of which I may submit the following extract from my 'Sketch of the Medical History of the Army in the Peninsular Campaigns:'*—

"Of the classes of society from which soldiers are recruited, I believe it will be found that, *cæt. par.*, tradesmen and manufacturers, particularly those of large towns, are soonest swept away by the fatigues and disease of an army; and that those who have followed agricultural pursuits are the most healthy. For example, 358 recruits joined the 7th foot in Portugal in 1810-1811; 201 of these were artificers and manufacturers, and 152 had followed agricultural pursuits. In the course of a few months 122 of the former died, and 62 of the latter: the proportion being 6 out of 10 in the former case, and 4 out of 10 in the latter."

4th. As the nearest possible approximation to accuracy, it may be stated that the proportion of men of the two classes above referred to, enlisted by recruiting parties and medically rejected, is—of countrymen about 20 per cent., and of men reared in large towns about 47 per cent.

3rd and 5th. There are no Returns or Reports in this department which enable me to answer Queries 3 and 5: the two classes under consideration being grouped *together* in the observations having reference to age and length of service in the Army.

I remain, &c.
(Signed) J. M'Grigor.

To J. R. Martin, Esq.
&c. &c.

* London Medico-Chirurgical Transactions, vol. vi.

REPORT

ON THE

STATE OF YORK AND OTHER TOWNS.

BY JAMES SMITH, ESQ. OF DEANSTON.

ONE OF THE COMMISSIONERS APPOINTED BY HER MAJESTY FOR INQUIRING INTO THE STATE OF LARGE TOWNS AND POPULOUS DISTRICTS IN ENGLAND AND WALES.

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REPORT *on the* CONDITION *of the* CITY *of* YORK.

BY JAMES SMITH, ESQ., OF DEANSTON.

Houses, 5958; population, 47,779; deaths, 2·4 per cent.; excess in number of deaths in 1841, 160; average age of death, 35 years 9 months; average age of death of adults, 56 years 9 months; proportion of deaths under 5 years to total deaths, 31·3 per cent.

THE city of York is situated on the river Ouse, a tidal river. The chief portion of the city is within the ancient walls, which in the olden time were surrounded by a fosse of considerable extent. The older and principal part of the city stands on the eastern side of the Ouse, sloping from the river's edge, with a gentle acclivity, and reaching a summit about 300 yards from the river, and from thence gently declining again into the general flat of the valley. The Foss, a small river coming from the east, and intersecting this division of the city, joins the Ouse by a lock, which has the effect of obstructing the natural flow of the stream, renders the river in a great degree stagnant, and causes the floods to inundate a considerable extent of the site of the city in that quarter. The flow of the stream of the Ouse itself is obstructed by a weir, placed across for navigation purposes, about five miles below the city. The waters of the Ouse overflow a portion of the site, near the margin on both sides, causing great loss, distress, and ill health to the inhabitants of the region. The city seems to have been placed in an extensive marsh, probably for defence in the olden times. The walls still remain of the original height, and so far shelter the city from the winds which blow towards the city over an extensive plain on all sides. But in calm weather they to a certain extent obstruct the ventilation; and it is found that the streets and courts immediately under the walls are the least healthy.

The ancient fosse at the external base of the walls has been for many years filled up, and the soil has been partially underdrained. I perceived, however, that the escape of the water in rainy periods is but slow, and towards the west the ditch has been less perfectly filled and drained, so that water stands over part of the surface at all times, and a mass of rushes indicates the presence of much under-water.

The streets are narrow, in many places curving and irregular, and the lateral streets and lanes are very narrow and ill ventilated. An important improvement was effected some years ago by opening out a roomy market-place in the middle of this division of the city; still there remains a great mass of very confined streets and courts. The chief slaughter-houses are in the very middle of this division, and a more confined and filthy locality I have never seen. There is no means of thorough cleansing the back premises, and the consequence is, a constant unwholesome atmosphere all around. The division of the city on the western side is far less extensive, with narrow and confined streets, and many very damp and filthy alleys and courts. In the southern corner of this division is the locality where the plague and other pestilences of former ages generally made their first appearance: here also the cholera first appeared in 1832; and at the present day fever is seldom absent. But for a more elaborate and scientific account of all matters relative to the sanatory condition of York in past ages and in the present time, I refer with peculiar satisfaction to the very able Report by Dr. Laycock, given in the Appendix to the First Report. The Report of Dr. Laycock, besides displaying much erudition, science, and industry, furnishes a long series of sanatory statisticts, embracing irresistible proofs of the progress of the sanatory condition of the population of the city, as the drainage of its site, and of the surrounding country proceeded, accompanied by better cleansing, and, I have no doubt, a better system of diet. This Report furnishes, also, from an ancient and aristocratic city, a view of the generally careless and inefficient workings of the public authorities during a long period of time, and shows that on several occasions, when disease became excessive, and the men in power and the better classes in general became alarmed for their own safety, they gave some attention to the undrained and filthy condition of the localities and abodes of the lower classes, and made some temporary efforts to remove the evils; but that no sooner had the impressive period of danger passed over than the drainage and cleansing were neglected as before; that not only were the old places left in their former condition, but even where new dwellings were from time to time constructed, no measures appear to have been taken to erect them on higher and drier sites, or to prevent the recurrence of former evils by systematic drainage and cleansing. The general progress of improvement in the country has induced a rather better structure of houses for the working-classes: they are still, however, defective; and the sewerage and the arrangements for dungsteads and privies are pretty much in the same state they seem to have been in 100 years ago.

York has not for many years been much extended—at all events in no ratio to the extension of most of the manufacturing towns; yet its slow increase does not seem in any degree to have led or enabled the authorities to give attention to the improvement of the condition of the streets, courts, and dwellings of the poorer classes. From the statements in the Report of Dr. Laycock (which is the Report assented to by the best-informed local officers), as well as from my own observations when I perambulated the city, and inquired into the sate of the sewerage, it appears that the general main sewerage is imperfect; and as to court and house drainage, there is none except in connexion with some of the houses of the better classes.

The aspect of York, as seen in the principal streets, is tidy and pleasing, and the streets, though narrow, are well kept; not so, however, the more retired and densely crowded parts, which have the same damp and filthy character as in all the other towns.

The supply of water is defective in quantity and in quality. The supply is not constantly on; branches are not carried into every dwelling; and the water being pumped directly from the river, is, in periods of flood, very brown and muddy, with an earthy taste; nor is the altitudinal pressure sufficient for extinguishing fires in the higher houses, or for cleansing purposes.

The smoke nuisance is not very great at York, though some steam-engines erected of late years on the west bank of the river have been complained of. None of the furnaces, so far as I could learn, have arrangements for consuming the smoke, and the chimneys are lower in height than steam-engine chimneys generally are in other towns, whereby the smoke is thrown more upon the houses in their immediate neighbourhood.

There is a nuisance of considerable extent arising from large depôts of dung, chiefly on the margin of the Fosse. These dung-heaps belong to "muck-merchants," who there mix the various qualities of matter collected; and which are permitted to ferment, in order to improve their appearance for sale. All around those heaps are pools of stagnant filthy water, and a most noxious effluvium is constantly emanating from an extensive surface.

The extensive vale in which York is situated is generally of an alluvial clay subsoil, the thorough under-draining of which has as yet made but little progress. The original swampy character has in a great measure been removed by the surface-drainage usually accompanying cultivation; but that complete and uniform dryness of the soil which follows thorough draining properly executed does not at present exist to any extent. Much of the land is flooded in periods of heavy rain, and misty vapours are seen hanging over the fields after much rain. Independent of the mischief to health caused by an atmosphere loaded with damp, there is a great amount of heat carried off from undrained land by the invisible evaporation which is constantly going on, and the heat of the sun is absorbed for hours and days by the evaporation of the water retained on a portion of the surface. The extent of open ditches necessary for the ordinary surface-drainage retains a large amount of stagnant water, which more or less loads the atmosphere with vapour, frequently of a miasmatic character, whereby diseases of various types are engendered and promoted. In some of the flat clay districts of Scotland, fever, agues, and rheumatism prevailed much before the introduction of thorough-draining, where open ditches and surface furrows were rife; but since thorough under-drainage has been introduced, and the ditches or main levels have been laid with conduits, and covered over, the inhabitants of those regions are full as healthy as those on the dry mountain-side. In the former condition of the drainage, these regions were in the autumnal months often covered for some hours with a dense fog, whereas, in their present condition, fog is never seen there when it does not generally prevail in other places. The profits to be derived by agriculturists from thorough drainage will induce in due time its universal adoption; and there is no estimating the extent of the beneficial effects it will produce in the improvement of the general climate of the country, the effects of which will be equally felt in large towns and populous districts, if not counteracted by imperfect drainage and sewerage, and by a filthy condition of the immediate locality of the towns themselves.

REPORT *on the* CONDITION *of the* TOWN *of* KINGSTON-UPON-HULL.

BY JAMES SMITH, ESQ., OF DEANSTON.

Houses, 8136; population, 41,130;* excess in number of deaths in 1841, 449; average age of all who died, 28 years; of adults, 52 years 5 months; proportion of deaths under 5 years to total deaths, 42·8 per cent.

THE town of Hull is situated at the confluence of the rivers Hull and Humber in the East Riding of Yorkshire. The site is upon a nearly flat surface of ground, a similar feature of surface extending for a distance of at least 10 miles to the eastward and north. The soil and subsoil are of a strong alluvial clay of considerable depth, resting upon the chalk formation. The general surface is about six feet above high water-mark of spring tides, the spring tides rising from low water to a height of about 18 feet.

The river Humber stretches along the west-by-south side of the town, and the distance across to the opposite flat land of Lincolnshire is above a mile. The Hull is a small river, coming from the flat country to the eastward, and approaches the Humber towards its junction, nearly at a right angle, passing through the southern section of the town. The Humber falls into the open sea of the German Ocean about 16 miles to the eastward. The town is unsheltered from the winds on all sides. Hull is a seaport of considerable antiquity, and there are extensive docks in the interior of the town from which there is a lockage into the Humber. As in most old towns, the streets are somewhat irregular, crooked, and narrow. The houses in the principal streets are high, having in general from four to five flats. Many narrow alleys cross from one street to another through the blocks of building, and those generally enter from the streets through closely-covered ways. Many of these alleys lead to and in some cases through small courts in which better classes of people reside, such as the families of the masters of the smaller vessels, and the mates of the larger; and it is remarkable that in those courts enclosed on all sides by large blocks of tall houses, and accessible only by long, narrow, and in most cases filthy alleys, yet, having a well-flagged surface, and being kept very clean by scrubbing and washing, the inhabitants are in general remarkably healthy and fresh looking. It is very pleasing, after having passed through a long, narrow and filthy passage to find yourself all at once in a court of from 20 to 40 feet square, or oblong, with a paved area washed as clean as the deck of a ship. The doors and windows of the dwellings are all as tidy as possible, and the windows have all clean muslin screens. In these localities the people are intelligent, cheerful, and civil.

The principal streets have covered sewers of considerable dimensions under the middle of the way, which discharge into the Humber and the Hull. The tidal water flowing into the sewers causes considerable obstruction to the free flow of the sewer water, promoting deposits of the *grosser matter* held in suspension; but it has been arranged that water can be made to flow into some of the sewers from the docks with considerable force at low water, and, this being regularly applied at intervals, those sewers are kept in good condition.

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* This is the amount of population in the Superintendent Registrar's district, which comprises nearly the whole of the town of Hull, and upon which the rate of mortality is calculated. The Borough contains 65,670 inhabitants.

The surface and sewerage water is in general conducted towards the sewers in open channels, and these channels in most cases have a tardily flowing stream of dirty water and filth exhaling most offensive and noxious gases. During high-water of spring tides the water pervades the whole of the sewers and drives the foul air from the area of the sewers into the atmosphere of the streets through the open gully-holes which are placed at intervals to admit the water from the surface. These constant communications from the sewers to the surface of the streets, permitting a stream of unwholesome emanations from the putrid matter in the sewers to flow into the atmosphere, which, mixing with the air breathed by the inhabitants, greatly deteriorates their general health.

The surfaces of the principal streets are paved with whinstone or granite blocks and with boulders, and are tolerably smooth and even, but still there are inequalities and hollows from neglect of the sunken and worn stones which hold pools of water in wet weather. The foot-ways are mostly flagged, and are tolerably smooth. In many of the streets, however, there are no foot-ways, and the open channels of the streets run along by the walls of the houses. Many of the old cross streets are without sewers or under-drainage of any kind, the filthy water flowing or being too often stagnant in open channels. In many of the more recently-formed streets there is neither sewerage, paving, nor macadamizing of any sort; the whole surface is broken and rough, retaining the water that falls from the clouds, which becomes putrid, and the nuisance is in many cases greatly aggravated by the slop-water and filth thrown from the doors and windows of the houses.

There are many vacant spaces of ground remaining to be built upon, which are left in a totally neglected state. The surface is in general low, and full of hollows retaining water; and all sorts of rubbish and filth are from time to time thrown down promiscuously, without any regard to evenness of surface; nor are any of these spaces under-drained, so that, from the tenacious nature of the soil, every drop of water is retained upon the surface. The greatest nuisance to which Hull is subject is that arising from a great extent of open ditches which surround the town and cross through several sections of it, receiving the sewage water from many localities, and containing at all times a mass of filth, decomposing and emitting bad smells and noxious gases. These ditches have hitherto been perpetuated in a great measure from the circumstance of the division of the site of the town into different districts, and these being under different authorities as regards the drainage and sewerage, one of the authorities refusing, to all the others, liberty to carry these channels for sewage through their territory, although it is in the best direction for fall. Typhus fever and, in some cases, ague are more frequent in dwellings near the margin of those open sewers than anywhere else in the town. The drainage of the agricultural country on the north and east of Hull is but indifferent. The great levels for carrying off the collected surface-water are by no means well arranged, and they are kept in very bad condition. The thorough drainage of the general surface for agricultural purposes has been as yet but very partially accomplished, and the consequence is that there is a very extensive exhalation during wet periods, and for some time after, which must be more or less hurtful to health. Such drainage is not of course immediately under the control of the town authorities, but they might use their influence in inducing the owners and occupiers to drain. The great benefits and profits, however, to be derived from thorough draining for agricultural purposes, are now becoming so generally known and appreciated that the parties for their own interest will most likely within a few years have the whole drained.

Another very marked and extensive nuisance in the town of Hull arises from the accumulation of the dung and filth taken from the dwellings in the town which is mixed and assorted, and laid up in depôts within the precincts of the town. The dung thus laid up often remains there for some time in the hands of the *muck-merchants* before being sent off to the farmers. Hull is known to be remarkable for having the greater part of the refuse and filth of the town carried off from the dwellings regularly, with the exception of that which is kept in private yards, each privy and ash-bin being cleaned every second day at furthest, and all except private ones twice a-week. Upwards of 400 people, including assistants, make their living by gathering muck from privies and ash-bins. Each muck-gatherer has an assistant, and in some instances a couple of boys: they go with a cart drawn by a small horse or donkey. The cart proceeds along the street stopping at the entrances to alleys and courts, the dung-gatherer with his assistants having a basket or bucket into which they put the ashes, vegetables, and other refuse, and the night-soil which they take from small ash-bins, most commonly situated under a privy-seat, so that the urine and the moisture of the night-soil are absorbed by the ashes, and the whole becomes a mass of good consistency, the moisture preventing the ashes from blowing away, whilst the ashes prevent the moisture from running. These bins in general have a bottom of flag or smooth firm earth, so that with a broad shovel the whole of the matter is easily cleaned up: the bucket is then carried to the cart and emptied into it, and another filling is gone for. The time during which the muck-gatherers are permitted to work is from five in the morning till eight; and during that time they carry, on an average, 230 buckets, 150 filling a cart, making 10 cwt. of muck. This each carries to his private yard, generally situated in the outskirts of the town, though sometimes in the interior. There the muck-gatherer assorts and mixes the dung to suit his customers, and disposes of it as soon as he can to some farmer or to some large muck-merchant or agent, who ships it for Lincolnshire or for some other farming district to which it can be water-borne. The price got for the prepared dung is about 3*s*. per ton, which affords the gatherer about 14*s*. per week, after paying for his assistants and horse. Taking the wages of the muck-gatherers with the wages of the assistants, and the cost of carting, &c. at 12*s*. per week for 400, there will appear a weekly cost of 240*l*., being annually 12,480*l*. In some cases, by agreement with the householders the soil is permitted to remain for two or three weeks. A very low grade of muck-gatherers called "snatchers" go about during the night or at very early hours and carry off occasionally such as has been left over. Thus a corrective is kept up to push the regular muck-gatherers to do their duty.

The general taking away of the ashes, privy-matter, and house-refuse frequently diminishes in a considerable degree the amount of filth and decaying matter usually found in every corner of large towns; still in many parts of Hull are to be found some very filthy courts and alleys.

Most of the slaughtering-houses are in the midst of the town, in a long narrow alley passing from the main street to a parallel street at a considerable distance. Those slaughtering-places are very confined, and generally have a muck-yard attached, which is filled with the offal, dung, and blood, taken from the animals, and most offensive effluvia are constantly flowing from the putrifying masses; the bloody matter, moreover, flows in streams along the open channels towards the covered sewers in the streets. Cows and pigs are kept in many places.

The scavenging of the streets is under the superintendence of the Surveyor to the Myton Commissioners, and the Surveyor to the Sculcoats Commissioners, and is upon the whole done well to the usual extent in such towns, but is far from reaching that state of cleanliness which is attainable and which is essential for the health and comfort of the inhabitants.

The police force in Hull is in a very efficient state; but they have no power to enforce the removal of many of the nuisances, and there is, in consequence, no thorough supervision of such matters by the police.

Most of the houses occupied by the lower classes in Hull are of the same description as those similarly occupied in all old towns, namely, the houses not occupied by a higher class in former times, with some modern erections built in some vacant spaces previously occupied. In the arrangement of these, little attention has been paid to the health and comfort of the inhabitants. There are no cellar dwellings in Hull, the rise of the tide so near to the level of the general surface of the streets preventing their adoption.

A better class of cottages have of late been erected in some places in which more attention has been paid to the important points. The most recent and most improved are let off in oblong courts open at one end to the street and generally closed at the other by a wall, and in some cases a dwelling. These courts are from 18 to 20 feet wide, well flagged on the surface with a fall towards the centre, where there is a covered sewer to receive all the surface and slop-water through openings grated over, or covered with a stone perforated with many small holes. A row of stand-pipes for supplying water is arranged along the middle of the court. No carts are permitted to come into these courts. The dwellings are arranged on each side, have a living-room below of from 14 to 15 feet square, with a little scullery in one corner at the back, and a very small back court in which there is a privy fitted to receive the ashes, &c., which are removed daily by the muck-gatherers: up-stairs are two small bed-rooms. Those houses are occupied by artisans and the better class of labourers. The buildings are of brick with slated roofs: the floors of the living-rooms are flagged, and there are no under-cellars. Some houses of the better class lately built have close sewers from each dwelling communicating with a main sewer, but still having to discharge the water from the main sewer into one of the open ditches formerly mentioned. There is a lack of fall, and the filth is accumulating fast in the sewers without any means of clearing it out by water. The sewers will have to be opened, and the mud must be taken out with buckets at great expense, and with much annoyance to the neighbourhood during the operation. I was informed by medical men, that fever frequently followed in the neighbourhood the opening of such sewers.

The prison situated in Sculcoats was most unhealthy until a proper sewerage was introduced, and trapped water-closets were adopted: now fevers are of rare occurrence.

The schools, of which there are several, seemed very well conducted, and are generally ventilated to a considerable extent, though not so Sculpletely as is desirable; at one poor-house school in the parish of comcoats, I found the rooms low and ill ventilated, the play-courts for the children undrained and full of water, and the privies in a very filthy state; and I learned that the boys were obliged to clean them out occasionally. There was evidently a great want of supervision.

The supply of water is deficient; but an Act has just been obtained for procuring a greater supply: much contention has existed between two parties in the attaining of the Act, the one contending for having the water from one source and the other from another. It is now believed by persons competent to judge that the source whence the water is being procured will afford water of a good quality, and there will be no difficulty in carrying the water into every house, and in keeping a constant supply at high pressure.

The evils arising from want of powers and from the want of a full and steady exercise of the existing powers, are obvious in Hull, as in other places; and the multiplication of surveyors and other officers causes trouble in carrying on the ordinary business, as well as in preventing improvements; and the expense is high, whilst the service is inefficient.

Connected with Hull there is an instance of the practicability and of the advantages of consolidating the collection of rates, as given in the evidence of Mr. Fox, printed in the First Report.

There are public subscription-baths in Hull, which are much frequented by the middle classes; and also, on Saturdays and Sundays, to a considerable extent by the lower classes.

Large cotton works were erected in Hull some years ago, which give employment to a portion of the young population, and especially to females of all ages. The works seemed well regulated, and are heated and ventilated in the usual manner followed in cotton factories, but by no means so complete in this respect as is desirable.

A few rows of cottages have been built at a little distance for the accommodation of a portion of the people. These cottages are not very well arranged, and are very untidily kept with the exception of a few dwellings. The ash-pits and privies are too much intermixed with the dwellings. The situation low, and damp, and badly drained.

Hull, upon the whole, as a seaport town, is respectable as to cleanliness, yet far from the desirable standard.

REPORT *on the* CONDITION *of the* TOWN *of* HUDDERSFIELD.

BY JAMES SMITH, ESQ., OF DEANSTON.

Houses, 4873; population, 24,000; excess in number of deaths in 1841, 266; average age of all who died, 27 years 3 months; average age of adults who died, 52 years 5 months; proportion of infant deaths under 5 years to total deaths, 40·3 per cent.

THE town of Huddersfield, in the West Riding of Yorkshire, is situated on a bank of land, rising from the valley of the river Colne: only a small portion of the town reaches so low as the river. The middle of the town is about 150 feet above the level of the river; the upper part about 200 feet. The aspect is towards the south and west. The surrounding country consists of valleys and rising grounds; and on the east and north-east, the surface rises rapidly to a considerable altitude above the town. The rocky formation is chiefly gritstone and freestone, of the coal formation, covered, in some places, to a considerable depth, with a bed of tenacious clay; so that, so far as regards the drainage of the general surface, it may be considered impervious. The surface of the surrounding country is in an undrained condition, at all events not thoroughly drained, and therefore may be considered to retain upon the surface much of the water falling in the shape of rain, thereby causing chilling exhalations and fogs: nevertheless, from the sloping nature of the surface, the bulk of the water flows rapidly off, whilst the prevailing and most salubrious winds are freely admitted, and thereby, so far, the situation of the town is favourable to a healthy condition of the inhabitants.

This town is peculiarly situated, as regards some parts of its local government. The whole of the land on which the town stands belonged to the late Sir John Ramsden, and now belongs to his son, a minor; under the guardianship of trustees appointed by his father, the whole power of arranging the streets of the town is retained for the proprietor. The late Sir John Ramsden did much for the ample width and proper arrangement of the streets; and, upon the whole, they are well arranged, of ample width, well paved, or macadamized. The main sewerage has been attended to. At the time of the cholera, the trustees agreed with the inhabitants that a sewer should be provided in every street; but owing to some misunderstanding betwixt the parties and the Board of Surveyors, the plan was not carried out.

The greater part of the town is of recent origin, and almost the whole of the houses have been erected on the sufferance of the lord of the manor, and without any agreement or lease, the parties building relying upon the honour of the family of the superior. In a few instances, proprietors of house property have had their premises taken possession of by Sir John Ramsden, for purposes of local improvement; but, in every case, a fair equivalent has been paid. Such want of tenure facilitates the progress of improvement, when under the care of a wise, enterprising, and honourable proprietor, but is liable to many objections, and could not be maintained in large communities. The management of the affairs of the community of Huddersfield is committed to a Board of Guardians and a Board of Surveyors, elected by the rate-payers.

There are in Huddersfield many unpaved streets, many without sewers, and a considerable extent of damp and filth in the streets, courts, and alleys; and, in such localities, fevers, and a lower tone of general health prevail.

The private courts are considered to be beyond the jurisdiction of the authorities, and the cognizance of the police; and, although in many places crowded with pigsties, filthy and extensive dunghills, and open privies, they are permitted to remain a nuisance to the neighbourhood, and excessively injurious to the health and comfort of the inhabitants themselves; and, although each individual complains of the nuisance caused by his neighbour, he refuses to remove the nuisance caused by himself. Efforts are now making by the Board of Surveyors to extend the sewerage, and what is going forward is well executed, structurally; but, from the want of sufficient fall in some of the cross streets, there will be a tendency to sludge up with mud; and no means are provided for directing, from time to time, a sufficient current of water through the sewers to clear them out. The sewers are here deeply laid, and are cut partly in the rock, partly in stiff clay. The depth has had great effect in laying dry some low-set houses and cellar-dwellings, at a considerable distance from the drains, which were formerly either damp or subject to flowings of water over their floors. This shows the great efficiency of deep under-draining in rendering dry the sites of houses.

The streets and roads of Huddersfield that are fully formed are paved with gritstone blocks, and in many places are macadamized; and the streets, especially the paved streets, are well kept on the surface, as to smoothness and cleansing. A system of washing would suit well on the streets of Huddersfield, from their smoothness, and from having a considerable declivity.

Some experiments were made by attaching a hose-pipe to one of the service pipes at a fire plug, and jetting it upon the street, and over the front of a building, (the George Inn): the front of the inn was well cleansed from top to bottom, in about 15 minutes, and the streets and pavement, to a considerable extent, were well cleansed in an equal period of time. The expenditure of water was not ascertained, but from experiments made elsewhere, as to the quantities discharged in a given time, and with a given pressure, through a nozzle of an equal diameter, it was estimated that 80 gallons were discharged per minute, or 1200 gallons each quarter of an hour. 1200 gallons would cost about 4*d*., and allow 2*d*. for labour; the cost of washing the front would be 6*d*. Taking again 1000 yards of streets cleansed from one point in 15 minutes, the cost would be 6*d*., that is including establishment charges and everything. Under ordinary circumstances, a common scavenger will sweep over 1000 yards per day, at a wage of 1*s*. 6*d*. Taking into view the more thorough cleansing by water, it will be seen that streets regularly cleansed by water would not be more dirty at the period for cleansing than streets being swept are at the moment each sweeping has been just completed. The thorough cleansing effected by water would diminish in an immense degree the continued exhalations of damp from the surface of the streets, after a period of rain, and would cause a great saving to the inhabitants, by the diminution of the quantity of mud carried into their dwellings by the feet of persons going in from the streets. In dry periods, the quantity of flying dust would be greatly diminished, and the expense of the ordinary watering of streets would be wholly saved.

At the Huddersfield Infirmary, I found a marked instance of the influence of bad sewerage in promoting fevers. A new house had been built some years ago for the infirmary: every pains were taken in the structure to provide for ventilation; but the drainage was executed much on the usual plan: sewers were carried under the passages of the low flat, to receive the water from the water-closets, from the scullery, and from the baths, and the slop-closets of the upper floors. A drain was carried from the building at the back, towards the front, passing round one end of the building, and going along a lawn in front, to a sewer in a street about 60 to 70 yards distant. The structure of the drain was of the usual style of dry stone building for drains, without cement, and of course pervious to water and air. The sewer water was thereby permitted to pervade, to some extent, the adjoining soil, and the gas generated by the decaying matter in the drain, passed through the soil into the atmosphere, so that bad smells were continually felt in the house, and in the open air, all along the line of the drain; and fever was seldom absent from the house. After some time, it occurred to the medical attendant that the effluvia from the drain must be the cause of the continued fever, and of a difficulty found in the cure of surgical cases. There being some old coal workings under the site of the building, it was suggested to make an opening into the workings, and to discharge the sewer water into them. This was accomplished, the bad smells were no more felt, and the fever ceased to prevail, whilst surgical cases proceeded generally in a satisfactory manner.

REPORT *on the* CONDITION *of the* TOWN *of* LEEDS.

BY JAMES SMITH, ESQ., OF DEANSTON.

Houses, 33,902; population, 168,000; deaths, 2·7 per cent.; excees in number of deaths in 1841, 1169; average age of all who died, 23 years 4 months; of adults, 51 years 1 month; proportion of infant deaths under 5 years to total deaths, 46·9 per cent.

THE town of Leeds is situated on the right and left banks of the river Aire, a navigable river in the West Riding of Yorkshire. The town lies chiefly on a slope of considerable acclivity, running towards the south-east from the margin of the river. The substrata of the site of this part of the town are of the coal measures, and the surface covering is a tenacious clay of several feet in depth, the rock coming near the surface in some places. The general character of the subsoil is retentive. On the opposite side of the river, stretching towards the west, there is an extensive flat, on which a considerable extent of buildings has in late times been erected, and the chief extension of the town is now taking place in that direction. Here are the Holbeck and Hunslet districts. This flat is traversed by two brooks (the Holbeck and Hunslet), which form the natural main sewers of the district: in these the flow of water is, however, retarded by various artificial obstructions which cause frequent overflowings of the ground, and at all times retain masses of putrescent matter in the channels of the brooks. The natural flow of the river Aire is obstructed by weirs placed across for navigation and mill purposes; the consequence of which is, that the water of the river is kept very much in still pools, and the lower streets, and houses on the margin are flooded occasionally. Some water-courses for mill purposes, called "the Calls" pass along a considerable distance near the margin of the river, causing floodings and damp. The obstructions in the river have also the effect of overflowing the outlets of the Holbeck and Hunslet brooks, and consequently the whole natural drainage, and the sewerage flowing into these brooks, is obstructed. In some places the banks of those brooks have been raised above the level of the adjoining general surface, causing damp and preventing a proper sewerage. In a district so flat and extensive as this, there are no means of obtaining a perfect drainage and sewerage without a main level brought from a lower point of the river.

The general arrangement of the streets and alleys of Leeds is in the older parts very much as in all old towns, somewhat irregular and narrow; but, fortunately for Leeds, the main street is of ample width, arising, as I was told, from a practice of the olden time, of having gardens in front of the houses, the area of which has in later times been added to the street. The streets running parallel to the river are, however, narrow, crooked, and irregular. Streets more recently formed are more ample in width, and there are many very cheerful open streets where the better classes reside. The lower classes here, as elsewhere, inhabit the less comfortable and less healthy localities along both sides of the Addle Beck, a stream which intersects the eastern division of the town, and which is obstructed by many weirs and bridges of limited openings, and by the encroachment of buildings on its bed. A great number of dye-houses and other manufactories are erected on the margin, and interspersed with these are a number of dwellings which, from the damp and the pestilential effluvia arising from the decaying matter in the bottom of the Beck, combined with the smoke and fumes arising from the various works, are most unhealthy. But by far the most unhealthy localities of Leeds are close squares of houses, or yards, as they are called, which have been erected for the accommodation of working people. Some of those, though situated in comparatively high ground, are airless from the enclosed structure, and being wholly unprovided with any form of under-drainage, or convenience, or arrangements for cleansing, are one mass of damp and filth. In some instances I found cellars, or under-rooms, with from two to six inches of water standing over the floors, and putrid from its stagnation in one case, from receiving the soakage of the slop-water standing in pools in the street adjoining. The ashes, garbage, and filth of all kinds are thrown from the doors and windows of the houses upon the surface of the streets and courts; and in some cases, where a gallery of entrance has been erected for the inhabitants of the second floor, the whole of the slops and filth are thrown over the gallery in front of the houses beneath; and as the ground is often sloping towards the doors of the lower dwellings, they are inundated with water and filth, and the poor inhabitants are placed in a miserable and unhealthy condition. The privies, as usual in such situations, are few in proportion to the number of inhabitants. They are open to view both in front and rear, are invariably in a filthy condition, and often remain without the removal of any portion of the filth for six months. The feelings of the people are blunted to all seeming decency; and from the constantly contaminated state of the atmosphere, a vast amount of ill health prevails, leading to listlessness, and inducing a desire for spirits and opiates; the combined influence of the whole condition causing much loss of time, increasing poverty, and terminating the existence of many in premature death. Mr. Baker, a medical practitioner of Leeds, and for many years one of the council, published a few years ago a treatise on the Vital Statistics of Leeds, going very fully into this subject, and he has demonstrated very clearly and undeniably, from facts observed during a long residence, the evil effects of bad ventilation, bad drainage, and deficient supplies of water.

Many of the streets, alleys, and courts are unpaved, and some paved in a very imperfect manner. They are full of ruts and hollows holding water and filth. All vacant spaces of building-ground are left undrained and unenclosed, and with uneven surfaces; and in many cases the slop-water from the neighbouring dwellings drains into them, creating extensive ponds of filthy water. All sorts of rubbish and filth are thrown upon these vacant spaces, and they become a wide field of deleterious emanations. Pigsties are frequently erected upon them, and they are used as depôts for dung by the muck-gatherers. No cognizance is taken of their condition by the police.

In the Holbeck and Hunslet districts the streets have been laid off without reference to the best lines for drainage, and no systematic plan of drainage has been arranged. The river and the brooks overflow many portions of this district in rainy periods; and even in dry seasons the drainage is so imperfect as to leave stagnant pools of water in many of the streets and courts; and the houses having in general been set down without reference to any fixed levels, the lower floors of many are as far under the surface of the ground as to be continually damp. The greater number of the streets are unpaved, and consequently of uneven surface, full of ruts and hollows holding water; and as from the want of proper sewerage there are no house-drains, the slops and refuse from the houses are thrown upon the surface of the streets, which are in many places thereby raised some feet above the original level. All over this district the dunghills, ash-pits, and privies have been set down without any order, in some places encroaching upon the streets; and in the courts, the filth often covering almost the whole area.

The slaughter-houses at Leeds, as elsewhere, are a source of nuisance. There is a want of drainage, want of water, and want of efficient regulations for cleansing.

The main sewerage of the town is imperfect. There are sewers in a few of the principal streets, but in the greater number of streets and alleys there is no provision whatever for drainage or sewerage. The main sewers are defective in position and defective in structure; they discharge either into the river or into the Addle Beck. The water is often set back into the sewers by floods; and the gross matter in the water, sinking and sludging by the sides of the river, forms sources of much annoyance, and contaminates the atmosphere. Immediately after the passing of the late Improvement Act for Leeds, steps were taken by the Mayor and Council for having a general survey made relative to the sewerage, which was ably executed by Captain Vetch of the Royal Engineers; and a plan was furnished by him of a superior character, providing for the complete sewerage of all the streets, alleys, and courts, and carrying the main sewer clear of the river. Provision was made for carrying the accumulated water into a main covered sewer to a distance from the town, where it was proposed to prepare it for agricultural purposes. An attempt was made to execute a part of this plan under the resident surveyor, who at the start committed a blunder amounting to two feet in the level of the first sewer he attempted, which caused an extensive stagnation of the water. The council of the borough, under whom he acted, became alarmed at the want of success, and stopped further procedure. Sometime after, with a new council, a proposal was made to follow out Captain Vetch's plan. I was present on one occasion for nearly six hours listening to a debate on this important subject, and much was said to satisfy me that such Court acting alone was most incompetent for judging and determining on such matters. The chief theme of the speakers, in opposition to the adoption of the plan of Captain Vetch, related to what they very erroneously supposed to be the means of saving the pockets of the rate-payers, with very little regard to sanatory results. The mover and seconder were the only parties who supported the motion for adopting Captain Vetch's plans. A counter motion was made and carried to consider a plan by their own surveyor, which plan was more calculated to save outlay than to insure efficiency. The main sewers by this plan were intended to discharge their waters into the river at several points as heretofore, thereby continuing the pollution and losing the benefit of the sewer-water for agricultural purposes. The application of sewer-water for agricultural purposes being in some degree a new subject, new at all events to the councillors of Leeds, their inattention to that point is less to be wondered at; but the complete sewerage of the streets and alleys, and carrying the discharging point of the main sewer to a distance from the town, are points which almost all can judge of and appreciate. A careful economy in the expenditure of public money is most necessary; but health and capacity for labour, and even the comforts of a large labouring community, are now proved to be means to the production of wealth; therefore even to adopt inferior and incomplete plans for public works is a miserably narrow-sighted and false economy indeed, whilst it inflicts on the poorer classes an amount of suffering and misery not to be estimated in pounds, shillings, and pence. Those who, from whatever motive, obstruct the progress of such improvements as tend to the advancement of the moral and physical condition of their fellow men, incur a heavy responsibility of the waste of life as well as of money.

The recent Improvement Act for the town of Leeds has been drawn with a greater desire to improve the condition of the working classes, and the general health and comfort of the inhabitants of all classes, than has been shown in any other Improvement Act which has come under my notice, and the details are more founded upon right principles, and more minutely given than has hitherto been done; still there is a want of completeness. But it matters not how ample the powers confirmed by an Act of Parliament may be, or how complete and perfect soever the detail, if the executive be not so arranged as to be effective in carrying out the law. This can only be attained by a board of limited number, rendered independent of immediate popular clamour, though amenable to public opinion, well officered, and under some general supervision and control, as well to urge as to restrain, and whose intelligence shall, from constant and extensive experience, be ripening with the advancement of the general improvement of the age.

The benevolent institutions of Leeds, for the amelioration of the sufferings of the poor and unfortunate, are numerous and well conducted; but as in disease, and poverty and wretchedness, as in all evils, prevention is of more importance than amelioration or cure, so should the efforts of the intelligent, the benevolent, the rich, and the powerful of a community, be directed to the root of the evil. Remove all apparent physical causes of ill health and discomfort—remove the moral pest, ignorance, by giving timely and complete education in that simple class of substantial and practical learning which is best fitted for the working classes, and promote as far as possible a frequent and kindly intercourse by the middle and higher classes, with the bulk of the working people. Go into their streets, and their alleys, and their courts; form a personal acquaintance with them; notice their little excellencies, gently reprove their rudenesses; magnetise them, if I may so speak, with the contact of a better class of manners; engage their sympathies; let them know that a gentleman has softer and kindlier attributes than those of the necessarily stern magistrate, strict master, and driving manufacturer. You may in the outset meet with some disagreeable individuals, some taunts, some insolence,—but persevere; and as your intercourse increases, you will soften down all jealousy, refine all rudeness, and gain the confidence and affection of the many. I may state that, when the object of my investigations was understood, I was well received by the inhabitants, and so will all be who go with the like errand.

Until, however, the localities of the abodes of the working classes are rendered more approachable to the higher classes of their fellow citizens by the removal of the many disgusting objects of sight and smell which abound in every quarter, it is in vain to expect that any useful intercourse can be maintained. I learned that a few clergymen and missionaries, and occasionally some benevolent females of the middle classes, made transient visits to the abodes of the sick and the wretched; but I could not find that any general intercourse was anywhere maintained, or that any heed was given by those benevolent visitors to any attempt at the amendment of the deplorable association of filth and malaria in which the poor people were left. It seems that they invariably rushed from the disagreeable and disgusting locality as soon as their labours of charity were completed. The removal of the surrounding disorder they deemed as not in their province; though in reality even the evils they came to mitigate might, in a great measure, have been prevented by a timely attention to the removal of the primary causes.

REPORT on the CONDITION of the TOWN of BRADFOR

By James Smith, Esq., of Deanston.

Houses, 7,246; population, 132,164; deaths, 2·4 per cent.; excess in number of deaths in 1841, 696; average age of death, 20 years 8 months; of adults, 50 years 7 months; proportion of deaths of infants under 5 years to total deaths, 50·8 per cent.

The town of Bradford is situated in an irregular valley in the West Riding of Yorkshire. A stream, called Bradford Brook, intersects the town, and, from obstructions to the free flow of the water in its natural channel, by the erection of mill-dams and the encroachment of houses, it frequently overflows the lower part of the town, causing much havoc in the cellars and lower floors of shops and dwellings. There is sufficient fall for the natural drainage if it was not so obstructed. The principal part of the town stands on a steep hill-side, running towards the east. The extent, upon a level with the margin of the brook, is long but narrow. On the west the town rises also upon a hill-side of considerable steepness. The main streets are narrow and confined, and rise towards the summits on both sides. Some of the smaller cross streets are extremely steep, so that in many places the moisture from the dungsteads of the upper houses drains into the cellars of the houses beneath.

In one street, where some houses of a better class have been built, the one rising above the other on the steep, the drainage of the upper houses falling in upon those below, causes constant ill health to the inhabitants, and fever is seldom absent from the locality. Near this locality, in a low cellar, I found a wool-comber, with his family. He told me he had formerly lived on the heights, in a dry situation, where he and his family enjoyed a fair share of good health; but that since they came to live in the cellar, they have been visited with much sickness. He said he had come to that house for cheapness of rent; and I was able to show him, by reckoning up all the loss of wages from the sickness of himself and family, which he detailed to me, that he was a loser to a greater amount than the whole rent of the healthy house he had formerly occupied. He said he saw the force of what I said, and declared that he would look out for a house better situated. One beneficial effect of giving the people greater intelligence, by a more complete and proper education, would be to enable them to appreciate the importance of placing themselves, as far as possible, in localities favourable to health.

The general state of the surface of the streets of Bradford is respectable, but in most of the inferior and cross streets chiefly inhabited by the working classes, the condition is quite otherwise. Few of those are paved at all; none of them properly. In some streets a piece of paving is laid half across the street, opposite one man's tenement, whilst his opposite neighbour contents himself with a slight covering of soft engine ashes through which the native clay of the subsoil is seen proing, with unequal surface, and pools of slop-water and filth are le all over the surface. The dung-heaps are found in several ces in the streets, and open privies are seen in many directions. rge swill-tubs are placed in various places by pig-feeders for collecting the refuse from the families, for which they pay in some cases from 1*d*. to 2*d*. per week.

The main sewerage of the town has been very defective, but some movement has been made of late in executing some sewers in better form in some of the principal streets. The chief sewerage, if sewerage it can be called, of the inferior streets and of the courts, is in open channels, and from the rough and unequal surface of the streets, the flow is tardy, and the whole soil is saturated with sewage water. The main sewers are discharged either into the brook or into the terminus or basin of a canal which runs into the lower part of the town. The water of this basin is often so charged with decaying matter, that in hot weather bubbles of sulphuretted hydrogen are continually rising to the surface; and so much is the atmosphere loaded with that gas, that watch-cases and other materials of silver become black in the pockets of the workmen employed near the canal. The stench is sometimes very strong, and fevers prevail much all around. Taking the general condition of Bradford, I am obliged to pronounce it to be the most filthy town I visited; and I could see no symptoms of any improvement in the more recent arrangements for the abodes of the working classes. The scavenging of the streets is but indifferently done, and a depôt for receiving the scavenging of the streets and other filth has been established in the very rear of the Court House where the authorities meet.

The chief slaughter-house is in the middle of the town, and forms a most decided nuisance to its immediate neighbourhood. The sewerage is defective, and the supply of water for cleansing most deficient.

The supply of water for the inhabitants is very limited; but an Act has just been obtained by a joint stock company for procuring a better supply. At present a great part of the town is supplied by water-carriers, who bring the water upon carts and upon donkeys, and charge a halfpenny for three gallons, which is most expensive, especially to the poor inhabitants, and forces an economy in the use of this most important element highly injurious to health, cleanliness, and comfort. In the lower part of the town I found a butcher using water from a well freely in his premises, the effect of which was, that all disagreeable smell was removed; and the facility and quickness with which he cleansed the whole of his place and the flagged pavement in the street in front of his premises attracted my special attention. I estimated from his operations that a street, 60 feet wide and one mile long, could be thoroughly washed for 7*s*., including cost of water, charged at such price as it can be furnished for almost everywhere.

Mr. Clough, town clerk and clerk to the Commissioners of Highways, who takes charge of the streets and sewerage, has given in a very excellent paper on these subjects, and shows clearly the want of a proper system of management. Mr. Clough's report will be found in the Appendix.

The schools in Bradford are in general well conducted, and in some cases the school-rooms are well ventilated: upon the whole, there seemed too limited an extent of school accommodation for so large a community.

More has been done in Bradford towards the diminution of the smoke nuisance than in any other town which I have visited. Most of the extensive manufacturers have applied some one of the many plans for consuming the smoke of their steam-boiler furnaces within the last three years; and I was informed that at one time the whole of the plans worked with more or less beneficial effect; but at the time I visited Bradford the greater number were out of order, some from one cause and some from another, and volumes of dense smoke were seen pouring out all over the town. On inquiry, I found that some of the apparatus were rendered ineffective by the breaking of a connecting wire, and some by warping of the iron plates from extraordinary heat; whilst all admitted that their respective furnaces worked well for raising steam by all the different plans, and that there was an undoubted saving of fuel from the use of the smoke-burning apparatus varying from 5 to 20 per cent.; but that from ignorance, carelessness, and some dislike on the part of the men employed as stokers,—from some small failures in the apparatus which there was little care to remedy,—from the want of some practical method of proving the neglect by technical evidence so as to bring the defaulters to punishment,—from the want of proper police arrangements and authoritative provision by officers responsible for taking measures for the protection of the public, notwithstanding the actual and undoubted general saving of fuel by the manufacturers by a better composition which diminished the smoke, the regular working of the apparatus was not generally effected; and that which was proved to be practical and beneficial was left unregarded. In the course of the examination of these places, and under my personal communication with the manufacturers, it was too frequently observable that many of them appeared to consider that it was not enough to prove that they did not lose money by the better consumption of their fuel and the consequent diminution of the smoke, or that they had some small amount of gain; many appeared to think that it must be shown that the gain was so large as to make it "worth the while" in their own estimation to be at the trouble of the change; no account being taken of the inconvenience and loss to which they subjected their neighbours or the surrounding population by the soot which they spread about them. As an instance of the difference between a smoky and a comparatively clear town, I may mention that a thrifty man at Hull, who had lived at Leeds, which suffers very severely from the excess of smoke, stated that he found he required one-third more of washing at Leeds than at Hull to keep his linen equally clean. Similar household observations have been made by persons who have resided in the neighbourhoods of ill-regulated furnaces and in towns comparatively free from them. There was expressed generally a belief that until some authoritative supervision shall be established, there can be no practical improvement obtained. In a town of such extent as Bradford, the immediate supervision might be placed in the hands of the police of the place, or, in the event of there being no police, in the hands of one or more special officers appointed for the purpose. As to a practical method of ascertaining the amount of smoke, several have been suggested. The only practicable mode of ascertaining the degree of smoke issuing which I have yet met with is that of having the representation of various degrees of shade printed in a book from a copper plate or lithographic stone, and these being numbered, each policeman or other watcher to have one of the books in his pocket; and taking it out when he sees smoke issuing improperly, he could at once fix on the number nearest the appearance of the smoke, and could give evidence accordingly. It matters not what laws are enacted to cure this or any other evil, unless a practical mode of detecting transgressions be adopted, and arrangements be made and persevered in for a constant vigilance, with an interest for detection given to the officers, and with a steady supervision over the whole. The police officers of a town are the best agents for observing and informing; and in peculiar localities, and under peculiar circumstances, local observers could be appointed, with a small weekly allowance over and above the premium for detection.

The factories for the worsted manufacture chiefly, seemed well regulated, and the children are healthy-looking. The wool-combing is admitted to be a very unhealthy employment. The wool-combers assort the wool chiefly in an apartment of their own dwelling. The work is done over a fire of charcoal, which sends forth volumes of carbonic acid gas, and the work-people are obliged to keep their windows open in all weathers to prevent, or to mitigate, the evil effects of the gas. They are roasted to perspiration on one side, and have often a current of cold air rushing upon them from the window. They look pale and cadaverous, and are short-lived, few reaching 50 years of age. Their roasting employment and exposure to the carbonic acid gas gives them a desire for spirits and opiates, and it is probable that the frequent free use of these may have some considerable share in shortening their lives. In some instances, where they have been brought to work together in factories, their health has been improved, and their habits have become better regulated.

When trade is good, the working people of Bradford make good wages, and they live well, so far as eating and drinking goes; and many have a taste for good clothing and good furniture in their houses, and save a little money; but the great bulk "make the day and way alike long." Many of the dwellings are built by building clubs composed of the working people, and they present little or no improvement in the mode of their construction.

REPORT *on the* CONDITION *of the* TOWN *of* SHEFFIELD.

BY JAMES SMITH, ESQ., OF DEANSTON.

Houses, 25,000; population, 85,076; deaths, 2·7 per cent.; excess in number of deaths during the year 1841, 721; average age of all who died, 22 years 6 months; of adults, 51 years 6 months; proportion per cent. of deaths of infants under 5 years, 49·7 per cent.

THE town of Sheffield stands chiefly on the right bank of the river Dun, at the confluence of the Sheaf, flowing towards the valley of Rotherham. The greater part of the town rests upon a ridge, rising to a height of about 200 feet above the river, and inclining beyond this ridge to another valley. A small portion of the ground, near the river side, is flat and low, and is liable to be flooded occasionally. The greater part of the town stands on the rising ground, the aspect of the chief part being south-east. The streets in the old parts are irregular and narrow; but having, in general, a considerable declivity of surface, they are both better ventilated and better cleansed by rain than the streets of most towns. The newer parts are laid off with more regularity. The streets are of moderate width, and are in general paved in a superior manner with gritstone blocks. The surface is kept even by constant attention and by cutting down any stones which rise above the general surface, or which do not wear so fast as the others.

The natural flow of the water, both of the Dun and the Sheaf, are much obstructed by mill-dams, the power acquired by which can be of no great value in a locality where coals are plentiful and cheap, whilst the obstructions they cause are of serious injury to the proprietors and inhabitants of the lower parts of the town. In the dead water caused by one of these dams, near the principal bridge, I saw the decaying carcases of several animals in association with a mass of filth from the sewers, which there discharge their contents into the river. A short distance below the bridge are the chief slaughter-houses, from which a deal of filth and putrid matter is constantly flowing into the river; the grosser matter is collected into dung-steads, in which pigs are kept, and are fed on parts of the viscera and other rejected parts of the slaughtered animals. The ways passing along the fronts of the killing-houses are roughly paved, having open gutters full of putrid matter. The chief part of the blood is saved in casks and sold to the farmers of Lincolnshire as a manure, at 1*d*. per gallon.

The under surface drainage of the surrounding country is very imperfect; indeed, the drainage is chiefly superficial; but from the generally steep declivity of the surface, the bulk of the water falling as rain soon passes off.

The sewerage is not carried so thoroughly out as it ought, but what has been done of late has been done well, on proper principles, under the direction of Mr. Lee, the surveyor of the town; and affords an example of the advantage of having a competent surveyor. I refer with satisfaction to a paper by Mr. Lee, given in the Appendix, on the subject of municipal arrangements, surveyorships, &c. Stones are used here for building the sewers, and which are generally made flat in the bottom and top, and are of comparatively small dimensions; but from the declivity of the surface, and the skill and care with which the work has been executed, they have been found quite sufficient, and have never been found to sludge up in any part. There are few house-drains, and none of the gully-holes are trapped. The streets are regularly swept and cleansed under the authorities, and the refuse is carried off by the scavengers and deposited in a dung-yard in the lower part of the town, where it is made up for sale. The scavenging costs about 900*l*. per annum, and about 600*l*. is got for the dung, &c. The steep declivity, the smooth and uniform surface and washing by the rain, and the absence of any dirty debris from the manufactures of the town, give it an air of cleanliness which is very agreeable, and so far it may be called a clean town; still there are many portions where the working classes reside confined, ill-ventilated, ill-drained, and filthy. In general however, the dung-steads and privies are more tidily kept than in most of the towns visited. The people themselves seem, in general, cleanly in their persons and houses, and have rather a healthy appearance. It appears, however, from Dr. Holland's excellent book on the "Vital Statistics of Sheffield," that several classes of the operatives are sickly and short-lived, especially fork-grinders. The statistical tables relative to Sheffield, given in the Appendix to the First Report, may be consulted.

Here, as elsewhere, the greatest amount of sickness prevails in undrained, ill-ventilated, and filthy localities. There is a flat and ill-drained portion of the town, on the south side of the river, where much fever prevails. The streets in this portion of the town are frequently covered with water several feet deep during floods, and many low dwellings are inundated, so that much danger and loss arises to the inhabitants. The houses are left damp and uncomfortable, and sickness, especially fever, always follows.

There are some cottages lately built for the working classes, which are of a very good construction. These houses are built back to back; but so well are they arranged that they have a good ventilation. The dung-steads and privies for the houses, both of front and rear, are in a roomy, open back court, and are as little of a nuisance to sight or smell as such objects can be; still they form an example of the unsuitableness of having any receptacles for an accumulation for weeks of the ashes, slops, and excrements so near to dwellings, or anywhere within the precincts of a town. The flagging of the courts is smooth and substantial, and kept clean by frequent thorough washing, for which water is supplied abundantly from a stand-cock in each court.

The sewer-water is discharged into the river, polluting the stream, and is lost for agricultural purposes. Part of this sewer water might be carried by gravitation to some lands a few miles distant for irrigation, and the water of the lower sewers might be pumped at no great expense to the level of the point of discharging the higher water.

Water is supplied in sufficient abundance for domestic purposes, but has not been used for cleansing of streets or sewers. It is acquired from surface drainage and from springs seven miles distant. The water is of good quality for all domestic purposes, but it is not properly filtered; and when I visited, the water served out as the water of the company was of a very bad colour, which was stated to be its common character. When water is received to a proper depth by thorough and proper drainage, it has passed through a natural filter and comes out comparatively pure from all such matters as are carried away in suspension by ordinary surface drainage. The expense and inconvenience of filtering all hill-side waters is so little to companies that it ought at all times to be required wherever there is not a proper filtration by thorough drainage. The better classes have the water carried by pipes into their houses, and the lower classes are supplied chiefly by stand-cocks adjoining their houses; they made no complaints of wanting a sufficient supply, though it is evident that water supplied at intervals, as here, can never fully answer. Here the people have to fill tubs, in which the water often stands exposed to the sun and dust for a couple of days. The necessity of having these tubs and tanks, besides occupying space, which is of importance in such a town, more than doubles the owner's and consumer's expense for apparatus. The water has been analyzed by Mr. West, of Leeds, and is of excellent quality. It is supplied by a joint stock company. There are 25,000 houses in the town, and 19,000 are supplied with water. The charge is 7½ per cent. on the rental, being from 8*s.* to 10*s.* per house per annum, or about 2*s.* per head, which is less than ½*d.* per week to each individual. The water is on every day in some parts of the town, and three times a-week in the other parts. In the pipes, in the lower parts of the town, there is a pressure of 460 feet, and fires can be extinguished by a hose-pipe from the main. No material inconvenience is felt even from the very high pressure in the lower parts of the town.

Gas is supplied by a joint stock company in abundance, of good quality, and at moderate rates. The working classes seldom take gas into their houses. The alleys and courts are not well lighted; and I may here remark that it is of great importance for the cleanliness, police, and moral order, as well as for the personal comfort of the inhabitants, that every street, court, and corner be well lighted at night. Besides, serious accidents frequently happen to the working people from a want of light in the courts and alleys as they go to and return from their work in the dark during six months of the year, except during clear moonlight.

The affairs of the town were formerly managed by the master cutler and a council; now there is a mayor, aldermen, and council under a newly acquired charter of incorporation.

The powers given by the Improvement Act are considerable, but still unsystematic and incomplete in many points for enforcing sufficient drainage, sewerage, supplies of water, lighting, &c.; nevertheless, there are powers to admit of a very extensive mitigation of the evils affecting the health and comfort of the people, provided the authorities do their duty fully with a constant care, and competent parish and responsible officers are appointed and supported to exercise that care.

The police establishment is small, but effective. They take cognizance to a certain extent of cleansing in the streets, but private courts, though open, are stated to be out of their jurisdiction.

The lodging-houses are looked to by the police when any suspicious characters are about, but there are no regulations as to cleansing, nor as to the numbers of ~~persons permitted to sleep in~~ an apartment. The rooms are often crowded to suffocation, the whole floors covered with beds; and to add to the evils, the lodging-house keepers are often purchasers or collectors of rags; and heaps of filthy rags stowed away in corners and closets. Diseases of the worst type are frequently generated if not brought into these lodging-houses, by vagrants and trampers, and remain undiscovered for days and weeks for want of a regular surveillence.

The smoke nuisance here is not great, as the smoke arises chiefly from small fires, widely distributed over the town; and there is but a small proportion of large steam-engine chimneys. Nothing seems to have been done, however, to lessen the nuisance from the degree in which it has existed for years.

There are no public gardens or open space of any extent for the people to walk and enjoy themselves in, but the country is open and hilly, and there are public roads in all directions. There is a peculiarity connected with this town worthy of notice, namely, that the operative cutlers keep a pack of hounds, with which they are permitted to sport over the neighbourhood, which they do occasionally on foot, and with great discretion.

The working classes I found quite alive to the objects of the Commission, and such of them as I came in contact with afforded every information and facility, and expressed an anxious desire to be relieved of the filth; and, as a proof of their desire for cleanliness, I found the seats of the open privies in courts in many places cleanly washed.

There exists in the lower part of the town one very obvious and most unhealthful nuisance, which appears to have remained hitherto unnoticed by the authorities. It arises from the existence of an old mill race, which has been long abandoned; its outlet is closed, and it now remains a receptacle for sewage water and filth. A number of little courts of inferior houses are situated along the margin, and in some places a row of poor houses on the very brink. The locality is altogether unhealthy, and the seat of fever, whenever there are any cases of fever in the town.

Complaints are made of the offensive nature of the interments within the town. One churchyard in the middle of the town is peculiarly offensive. It is very much crowded with bodies, and as the soil is considerably above the level of the surrounding street, the exudation of putrid liquid from the soil is visible to the eye and offensive to the smell. The soil being of a tenacious clay, the decay of the bodies is slow; and where graves are opened, the skeletons are often found still articulated, and their exhumation is most offensive to the inhabitants residing within sight of the burial-ground. A cemetery has just been established at some distance in the country by a joint stock company, under good regulations. It is beginning to be resorted to, and it is to be hoped that the bulk of the interments will hereafter be made in this or some other similar place; for whether we consider the health and comfort of the inhabitants, or the softer feelings of the relatives of the dead, or, generally, feelings of public decency, we must approve of the arrangements of having burial-places in a remote and undisturbed locality.

REPORT *on the* CONDITION *of the* TOWN *of* HALIFAX.

Population, 109,175; deaths, 2·1 per cent.; excess in the number of deaths in the year 1841, 266; average age of all who died, 26 years 10 months; of adults, 53 years 9 months; proportion per cent. of deaths of infants under 5 years, 41·6 per cent.

The town of Halifax, in the West Riding of Yorkshire, stands on the sloping banks of the Hebble, a small stream flowing towards the Aire. The site of the town is situated very nearly in the middle of the county, and is elevated about 500 feet above the level of the sea.

The banks rise very steeply, and especially on the east, where they reach to a great height, and look almost like a wall rising above the valley. The under strata consist chiefly of a hard gritty sandstone rock, of the coal formation. The immediate surface is generally a strong clay, especially in the lower range of the valley, but assumes a lighter nature towards the heights.

This town is in part very ancient; but the increase of population has been greatly extended during the last 30 years, by the prosperity of the manufactures of the place; these are chiefly worsted spinning, and weaving, with an extensive manufacture of cards for carding cotton, wool, and flax.

From the features of the surface, the streets are in general steep, and being, upon the whole, well paved, they are much washed by rain, and except in some of the low and narrow streets, the ventilation and cleanliness are rather of a good order. The river or brook is much obstructed in its flow by the existence of many weirs erected from time to time for mill purposes, and, of course, the main drainage is not good although the natural capabilities are very ample. From the steepness of the sides of the valley, and the rapid fall in the channel of the stream, there is but a limited portion of the site in a low, flat, and damp condition. The streets are partially sewered, but still there is a great want of thorough under-sewering.

The streets are irregular in direction and width, with the exception of a few more recent streets which have a fair width, and are less steep. Other new streets on the rising ground are steep and winding; the latter are, however, well ventilated from their position, and there being little traffic on the well-paved streets, they are clean and tidy; with the fault, however, of much of the sewerage water having to run in open gutters. Near the margin of the river there are some damp, wretched-looking dwellings, and there is in some localities a class of dwellings for the lower orders called *folds*, which are a sort of courts or enclosed spaces. Most of these folds are very damp and filthy; the seats of poverty and disease. Such localities in every town are invariably found to be inhabited by the lowest grade of the working people; but who in the case of Halifax, though in the midst of filth, and with a low state of finances and morals, are nevertheless inclined to be cleanly and tidy, but are kept in a depressed condition by the outward filth and effluvium which assails them at every step. Houses of this class generally belong to public-house keepers, or a class of operatives who have contrived to save a little money: sometimes to building clubs.

The publican wishes to have around him not the most provident class. The small tradesman, penurious in his habits, will not expend a sixpence for the comfort of his tenant beyond necessity; and the building clubs being composed of many, all having a personal interest in the gains, but none in the comfort of their tenants, will not allow of any expenditure beyond what will secure tenants for the property, so that the drainage, ventilation, and cleansing are left to chance, as the public authorities take no notice of such localities.

The supply of water is from wells in the town, and from reservoirs erected by a water company, at some distance in the country.

The water is of fair quality, and, upon the whole, rather abundant, though far short of the supply necessary for thorough cleansing.

I found that the people of Halifax use water more liberally for washing their windows and floors, and even in many instances for washing their lanes and streets, than in any other town I visited. There is no very efficient means for extinguishing fires by a jet from the service-pipes or main; but, from the position of the town, the water might, by proper arrangements, be used for extinguishing fires by jets, and for washing the streets.

The town is very well supplied with gas. Still few or none of the working classes take it into their houses, and the streets are barely lighted. In some places here I found great receptacles for ashes and filth in cellars under the houses, and from which the manure was not removed more than twice or three times a-year.

The health of the general population is, however, good for a town population. In one locality it is remarkable that in a class of cottages situated in the higher ground, or country district, there is more fever than amongst the population of the town. The medical men attribute this very much to bad drainage—to the inhabitants having filthy muck holes in front of their houses, and to the cold and more exposed position of the locality.

Most of the young population are employed in the worsted factories and in card making. It has been generally observed, that persons employed in the woollen or worsted manufactures are more healthy than those employed in cotton.

There is an infirmary of recent erection, an elegant and commodious house, where great attention is paid to the patients, and to this excellent institution is attached a dispensary. The older infirmary building was situated in a low part of the town, where the drainage is bad, and the situation confined and airless. There the hospital fever often prevailed, and surgical cases were most difficult to cure, as I was assured by the medical men, from the effects of contaminated damp and miasmatic atmosphere. Ever since the patients have been received in the new building, there has been a complete change. The recoveries have been more rapid and sure, and surgical cases proceed in most instances satisfactorily.

Notwithstanding, however, the many excellent general arrangements of this building, the sewerage is of the old, common, unsatisfactory kind, the drainage from the water-closets, sculleries, &c., is carried under the floors of the rooms and passages of the lower flat, in common built sewers (not pipes), with cesspools, and the consequence is a constant emanation of bad smells, very much complained of by the house-keeper and her assistants.

The evil must more or less affect the patients, for the air from this lower flat pervades the whole house; though, being more diluted in its passage to the upper floors, the smell is less perceptible, and the vitiated air less hurtful.

The use of cesspools of any description is quite inadmissible, where purity of air is required, and wherever human beings exist such is required.

It frequently happens that where a small quantity of contamination is gradually but constantly emitted from cesspools, no obvious bad smell or effluvia is perceptible to common observers, still the surrounding atmosphere becomes sufficiently contaminated to produce in most constitutions a lowered tone of health, with very baneful ultimate effects to those long exposed to its influence.

The slaughter-houses of Halifax are situated in a large quadrangular space in the middle of one section of the town. The general arrangements are better than in most towns; yet there is much of the usual offensive and hurtful character of such establishments. The smell especially in the warm weather of summer, is much complained of by the neighbouring inhabitants, and the emanations from the putrid matter must influence their health to a considerable extent.

The sewer-water is in general discharged into the brook; the water of the brook is used to a limited extent at several places for irrigation, and although often much diluted with rain-water, it has a most beneficial effect. A steam-engine has for many years been at work for pumping the water of the brook in all states, however impure, for supplying a canal; and although the water of this brook often contains as much matter in suspension as the sewer-water of any town, it has been regularly pumped in large quantities to a height of 100 feet, without the slighest injury to, or difficulty with, the pumps; affording an excellent example of the practicability of pumping away the sewer-water of towns for agricultural purposes. In a subsequent paper on the subject of the application of sewer-water for agricultural purposes, I have availed myself of this example.*

The smoke nuisance is in no way materially abated; and, from the number of factories situated in the low part of the town having steam-engines, there is much smoke in the atmosphere at all times when they are at work, and which dwells very much in the locality, from the enclosed nature of the valley.

The general features of Halifax are favourable to health. Sheltered from the east and west winds by the rising ground immediately enclosing the valley, and having a rapidly sloping surface to carry off the rain-water, it wants but a better sewerage, especially in the lower parts, and greater attention to the frequent and regular removal of the filth, to render it an agreeable and healthful residence.

General Observations on the present Condition of Large Towns, as regards the Health and Comfort of the Inhabitants, and the means of Improvement. By James Smith, Esq., of Deanston.

The general defects of all the towns which I visited under this inquiry were—

1. Defect of areas for works of drainage, and consequent defect of the requisite extent of jurisdiction to enable any local administrative body to carry out such works properly.

The natural area as regards drainage was not in any case within the prescribed limits, and there is a difficulty in obtaining that free outfall which is essential to good drainage, and in many instances the drainage from the higher grounds is thrown upon the site of the town in such a manner as to cause much damp and inconvenience; whereas, if it were under the control of the proper authority, it might be converted from a bane to a benefit, by directing it into the sewers at proper points, so as to assist in scouring them out or for supplying a sufficient dilution to retard putrescence, and fit the fluid for pumping and distribution. The obstacles to the natural drainage caused by weirs and other obstructions in the brooks and rivers is general and most injurious, causing the overflow of the sites of a portion of the houses in the lower districts in periods of floods, and preventing at all times the proper depth and efficiency of the discharging sewers.

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* Report on the Application of Sewer-Water to Agricultural Purposes.

Thus at Hull: that which is really one town,—Sculcoats as well as Hull,—is split into two clashing jurisdictions; necessitating double sets of officers, double superintendence to each, or excessively expensive establishments, inferior powers of execution, and a clashing in their action. Sheffield is another example: the town is cut up into two districts,—Ecclesall Bierlow and Sheffield.

For the sake of economical and efficient administrative arrangements, the collective mass of houses forming a town and the suburbs ought to be under one jurisdiction for these purposes, even if it happened to include in its site distinct drainage areas.

The drainage area ought to include its outfalls. From ignorance or from neglect, the public jurisdiction over the outfalls at Sheffield, at Halifax, at Leeds, and at Bradford, had been allowed to be encroached upon, and dammed up for mill power. These dams are made the catch-pits for the sewage of the town, and the effect of the miasma from the stagnant pools produced is most pestilential. The legal validity of these encroachments, I am told, admits of question, but inasmuch as small interests in possession, with apprehended loss, are much more active than any large public interest, it seems to be good policy for the sake of the population, that all such interests should be bought up liberally. By the poor people, when the nature of our inquiry was understood, it was everywhere well received. But a louring front was occasionally met with on the part of persons in a condition of life where it might not be expected: sometimes an aspect was exhibited of disapproval of interference "with local self-government," and intrusion; and allegations were heard that the people disliked to be interfered with, and liked dirt, and would not have their habits disturbed. Every such manifestation turned out to be from the possessor or sharer of one of these immense catch-pits, or some pestilential interest or other, which a complete system of cleansing and purification would apparently disturb. In the perambulation of the lower districts inhabited by the poorer classes, it was often very affecting to see how resolutely they strove for decency and cleanliness amidst the adverse circumstances; to see the floors of their houses and the steps washed clean, made white with the hearth-stone, when the first persons coming into the house must spoil their labours, with the mud from the street, kept filthy by neglect of proper scavenging; to see their clothes washed and hung out to dry, but befouled by soot from the neighbouring furnaces; and to see their children attempted to be kept clean, but made dirty from the like causes; and sometimes to see those children, notwithstanding all their care, pale, sickly, and drooping, evidently from the pestilential miasma of a natural stream, converted into a sewer, and dammed up for the sake of mill power, in the hands of persons of great influence in the return of members to the town council, who are deaf to all statements of evidence of the evil, or of the possibility of amendment.

2. What would follow as a consequence of defective areas in respect to the larger works,—imperfect works within the imperfect areas. In the towns examined, I found that there exists a general want of sufficient sewerage for carrying off the rain and sewerage water from the streets. A complete want, almost without exception, of such branch communications from the dwellings and courts to the sewers as would remove the nuisance and injury to health arising from putrid and offensive water and other matter flowing in open channels, and in most instances a total want of such under-drainage as is necessary to render the sites of the houses and of the streets dry.

In many instances either cellar dwellings having their floors from four to seven feet under the level of the surface, or dwellings having their first floors under the level of the ground or just level with it, are the chief residences of the lower grades of the working classes.

The depôts for the ashes and filth of the families are generally immediately adjoining the dwellings, open to view, frequently covering large spaces of the courts or streets, and with privies attached exposed in defiance of all feelings of decency, and in all most offensive to sight and to smell, and constantly emitting effluvia hurtful to health. The people in general are most sensible of the evils, and make every effort to induce the proprietors to have the nuisance removed or abated, but seldom succeed. The dung is in few instances removed oftener than once in six months, and then an extensive surface, exhaling offensive effluvia from the saturated ground, is left exposed.

There is want of a well-regulated system for the regular scavenging or otherwise cleansing the alleys and courts, and in general a want of power to have cleanliness enforced and nuisances removed from private courts and premises:

A want of power or arrangement for cognizance of such by the police, whose interference is chiefly confined to such matters in the public streets only:

The want of sufficient and constant supplies of water at high pressure for ordinary domestic purposes, and for more thorough cleansing:

A want of sufficient lighting by gas in the alleys and courts.

There is a great want of width and openness in the streets, alleys, and courts, especially in those parts inhabited by the working classes. Houses are built without means of ventilation sufficient for the number of individuals generally living in each apartment.

Regulations for the enforcement of the formation of sewers and paving of streets in all cases of extension are much wanted.

A want of some general supervision of the public economy of large towns, whereby the complete and uniform action of the management of the various trusts shall be insured, whilst means shall be afforded for comparing the system of management and the modes of working, and the cost and the results of one town with those of another, thereby leading to a knowledge of the best system, and to emulation amongst the towns.

3. These defective works are further aggravated by the defective powers of the existing local authorities, whereby the increments of the towns for the accommodation of the increasing population might be regulated.

4. Defective constitution of the local authorities.

It must not be concealed that the new works required for the improvement of towns require a degree not only of intelligence, but an amount of sustained attention too great to be treated as an incident to the ordinary duties of town councils.

This was displayed in a marked manner at Leeds. There the excessive sickness and mortality arising from defective administrative regulations had been demonstrated by Mr. Baker, surgeon, resident at Leeds, in a report which had been widely promulgated. He had demonstrated the identity of the cholera track and the fever track precisely in the line of bad drainage, bad public cleansing, close, crowded, and ill-regulated habitations.

The chief remedies had been demonstrated to the satisfaction of the mayor and a number of gentlemen of education in a very able report by Captain Vetch. He had demonstrated the falsehood of the cry of "increased rates;" he had shown that the whole might be accomplished with a considerable ultimate reduction of the existing charges.

But neither the demonstration of the evils nor of the remedies has availed the population. A local Act had been procured, but with defective provisions; and those provisions, executed as self-acting and unsupervised laws are everywhere found to be, and are proved to be by the actual existing state of evils intended to be remedied. And that scientific demonstrations in general, such as those with relation to areas of drainage, trigonometrical surveys, the laws of gravitation, or the laws of hydraulics, involved in the cleansing of towns by the removal of matters in suspension in water, the application of these principles to the maintenance of supplies of water at high pressure, a principle, simple as it is and fully demonstrated, is yet not so popularly understood that those who suppose they have an interest against the extension of reservoirs and the necessary works may not for some time be successful in denying them, we might fairly expect that they will be of little avail with unscientific persons, such as, without disparagement to their respectability as citizens, the members of town councils may be stated to be.

But were it otherwise, and however well appreciated such works might be locally, yet they would require a very laborious supervision. To put a stop to the smoke nuisance at Bradford properly and easily might require the attention of a person of sufficient science to understand the management of fuel in furnaces; but if any unpaid functionary, possessing such qualifications, were to give the labour requisite for the proper performance of the duties in question, though he might save from 5 to 15 per cent. in the manufacturer's consumption of fuel, and an immense sum in extra washing and wear and tear of clothes to the inhabitants, he would probably be set down as a madman. Another element which presented itself as a serious barrier to the carrying out of local works by the authorities as at present constituted,—namely, party divisions. At Hull, when I visited the town, and paid my respects to the mayor as a public officer, without knowing nor thinking it my duty to notice of what political party he was, and made inquiries of the municipal officers, and perambulated the poorer districts with them, I found that this very innocent act of mine was regarded by very respectable persons, but an anti-corporation party, as "taking a side."

The supplies of water for the town I found had been for a long period in the hands of the corporation. They had recently obtained an Act for the extension of the supplies of water. Into the particulars of the mode of supply I had not time to enter; but that a considerable extension of the supply was required for the general use of the population was obvious to me. Nevertheless, I found that the extension of the supply was deemed a party measure, the sufficiency of the existing sources strongly contended for, and the measure was bitterly opposed by many respectable persons. By the Act, the profits derivable from the water rents are limited to 6 per cent. on the outlay. I had no time or means to inquire into the propriety of this outlay; I heard no specific allegations against it, and presume that it was unimpeachable or satisfactory. Nevertheless, we must not shut our eyes to the general examples of extravagant expenditure we have had in local public works; and supposing this particular work to be well managed, what is the general tendency? A corporation of any political party might very easily double the original outlay for the works or the staff of officers or turncocks for their management, and it was impossible not to feel that the rate-payers might be more cheaply served in the long run, if the whole service of the water supply were let out on contract for a term of years, and that the whole arrangement would have worked more satisfactorily to the extent to which it was freed from party influences. The supply of water was intermittent. The advantages of a constant supply of water in the reduction of the tenants' expenses of tanks, in the readier means it afforded for private baths, and for cleansing streets, had not been seen or provided for.

From all these considerations it was evident,—from the state of the areas, the jurisdictions, and the works in the towns, which I visited,—that very special local arrangements, freed, as far as possible, from party conflict, would be required to carry them out. The feeling of distrust of the inhabitants against any new rates or expenditure, derived from their experience as to past expenditure, is one of the most effectual bars to the advancement of improvement, leading to narrow and contracted views on all points, and disposing to the adoption of cheapness and saving with necessary inefficiency, in place of liberal views and efficient plans and operations. If it is possible to find the necessary pecuniary means without a rate, the chief difficulties would be removed. I have submitted in a separate paper my views of the facilities of obtaining large pecuniary resources by the application of the sewer water.* With such source of supply there will be no difficulty in designing, executing, and keeping up a most perfect system as far as our present views extend, of works and regulations for securing the greatest amount of health and comfort which can be attained for the inhabitants of large towns.

If a rate must still, under some circumstances, be resorted to as the only source, or as a helping source for procuring the necessary funds, the adoption of the principle of dividing the charge over a series of years, and raising the money immediately required by loan on security of the rates, will greatly diminish the immediate pressure, and so far remove the hostility of the rate-payers to necessary and efficient works of improvement. Besides, substantial justice will be done to liferenters, many of whom have no other source of living but by a limited amount of rent drawn from house property. Nevertheless, I believe that this jealousy might be abated by a properly adjusted and revised system of contract management, which would be cheaper than any other.

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* See Report on Profitable Application of Sewer Water, p. 172.

As against new expenditure we have to set the actual existing expenditure, the existing charges for the cleansing of cesspools would in general, under a system of contract management, suffice for the laying down an improved system of soil-pans and drains, and carrying water into every house to cleanse them. It certainly would be so at Hull. Then there is the enormous waste of productive labour in excessive sickness and premature deaths. To display this, I have thought it convenient to adopt the same heads of returns of sickness and mortality during one year that have been adopted by my colleague, Dr. Lyon Playfair, for the display of the expense of premature mortality in the several towns and districts of Lancashire, with which those I have examined may be compared. Though the mortality of some of the town districts appears to be greater than might be expected on a cursory view of them, yet it is in general coincident with the physical condition in which the population is found to be on a close examination, and there can be no doubt that by proper measures of water supply to the houses, proper house-drains and cleansing, the entire suppression of cesspools, the removal of grave-yards and slaughter-houses, and the suppression of the smoke nuisance, and proper ventilation, the physical or sanatory condition of the population of town districts might be brought up to the condition of the present best conditioned rural district in each part of the country; for in those districts themselves the drainage is imperfect, epidemic diseases are prevalent, and there is evidently much to amend.

From this table, the poor artisan at Bradford might see that, for a wretched tenement, he sacrificed, under a notion of saving, such as prevailed with the town council at Leeds, no less than 16 years' chances of life and money earnings during that time, estimating them only at 7*s.* 6*d.* per week, of 184*l.* The town council of Leeds may see that their year's excess of deaths from preventible disease in 1841 was 1169; that the year's funeral bill for this excess could not have been less than 5800*l.*; that the bill for the excess of sickness during that same year for the town is moderately estimated at 32,700*l.*; and that the loss of productive labour swept away by that one year's excess of mortality could have been no less than 817,000*l.* to the country.

YORK WEST RIDING.

REGISTRATION DISTRICTS.	Average Age at Death of all who Died.		Average Age at Death of all who Died above 20		Proportion per Cent. of Deaths to Total Deaths												Proportion per Cent. of Deaths to Births	
					Under				Between							90 and upwards	Under	
					1 Year.	5 Years.	15 Years.	20 Years.	20–30	30–40	40–50	50–60	60–70	70–80	80–90		1 Year.	5 Years.
	Yrs.	Mo.	Yrs.	Mo.														
Saddleworth, Ecclesfield, Wortley, and Ecclesall Bierlow	26	3	52	10	23·8	43·2	52·0	55·6	8·0	6·0	5·5	7·0	7·6	6·6	3·5	0·3	14·0	25·4
Sheffield	22	6	51	6	25·4	49·7	56·7	59·9	6·6	6·1	6·7	6·0	6·1	6·3	2·1	0·1	16·7	32·7
Rotherham	28	5	54	6	23·3	33·5	45·8	53·1	8·4	5·6	4·4	7·5	8·4	7·4	4·7	0·4	13·5	18·3
Wakefield	30	5	53	11	21·9	35·2	42·6	46·9	9·1	6·8	8·1	5·7	9·3	9·3	4·2	0·6	12·7	20·4
Huddersfield . . .	27	3	52	5	26·0	40·3	47·2	51·4	9·4	6·9	6·3	6·1	7·1	8·9	3·6	0·2	13·8	21·4
Dewsbury	23	6	52	0	28·2	46·2	53·6	59·0	7·7	6·6	5·6	4·9	6·4	5·7	4·0	0·2	14·1	23·2
Halifax	26	10	53	9	24·8	41·6	48·5	53·9	7·6	6·5	6·2	6·4	6·7	8·6	3·8	0·3	14·1	23·6
Bradford	20	3	50	7	29·5	50·8	58·9	64·6	7·7	5·2	4·5	5·3	5·1	5·2	2·3	0·2	17·0	29·6
Leeds	23	4	51	1	25·8	46·9	54·7	58·2	7·3	6·9	6·7	5·4	7·3	5·3	2·5	0·3	16·8	30·5
Otley and Keighley .	28	5	54	11	25·8	40·1	46·9	51·7	8·7	7·1	5·0	5·3	7·1	7·6	6·5	0·9	14·9	23·2
Skipton, Sedbergh, and Settle.	31	11	55	8	19·9	33.8	41·2	46·3	9·1	6·7	5·8	6·0	8·5	10·2	6·3	1·1	12·9	22·6
Pateley Bridge, Ripon, and Knaresborough.	36	3	60	0	20·1	31·0	38·8	42·6	7·6	5·1	5·8	6·5	9·1	12·8	9·1	1·2	12·8	19·8
Selby, Goole, and Pontefract	29	1	59	4	26·4	42·3	50·9	54·1	6·4	4·2	4·3	5·2	7·4	10·5	6·8	0·9	15·6	24·5
Doncaster and Thorne	32	5	58	2	20·0	34·5	44·1	46·6	6·8	6·5	5·7	5·4	8·6	11·6	6·6	1·2	13·4	23·2
Average . .	25	11	53	6	25·2	43·2	51·0	55·3	7·8	6·3	5·9	5·8	7·1	7·5	3·9	0·4	15·0	25·8
Total Number of Deaths	..		..		6,161	10,580	12,495	13,554	1,903	1,527	1,440	1,425	1,738	1,831	967	107	..	..

		Extreme Districts.	
		Pateley, &c.	Sheffield.
Total Number of Adults prematurely dying	6,295		
,, to every 10,000 of the Population	56	44	67
Number of all Classes dying from Epidemic, Endemic, and Contagious Diseases	4,343		
,, to every 10,000 of the Population	39	23	51
Deaths of all Classes from Diseases of the Respiratory Organs.	6,227		
,, to every 10,000 of the Population	55	34	74

Excess beyond the Loss of Life experienced at Pateley Bridge, Ripon, and Knaresborough, preventible in each District.

REGISTRATION DISTRICTS.	Excess in Number of			Years' Loss of Life to		Total Loss of Money Value of Productive Labour at 10s. per Week Men, and 5s. per Week Women; say 7s. 6d. per Week to each Adult Individual.	Total Loss on the Year's Deaths in			
	All Deaths.	Deaths of Adults.	Births.	Every Individual.	Every Adult.		Sickness.	Funerals.	Labour.	Total.
				Yrs. Mnths.	Yrs. Mnths.	£.	£.	£.	£.	£.
Saddleworth, Ecclesfield, Wortley, and Ecclesall Bierlow	331	113	845	10 0	7 2	140	9,268	1,655	145,600	156,523
Sheffield	722	27	1,032	13 9	8 6	166	20,216	3,610	148,404	172,230
Rotherham	59	26	188	7 10	5 6	107	1,652	295	28,569	30,516
Wakefield	160	50	406	5 8	7 1	138	4,480	800	71,070	76,350
Huddersfield	219	63	1,018	9 0	7 7	148	6,132	1,095	152,292	159,519
Dewsbury	157	112	775	12 9	8 0	156	4,396	785	79,092	84,273
Halifax	256	96	856	9 5	6 3	122	7,448	1,330	22,352	31,130
Bradford	696	271	1,541	16 0	9 5	184	19,488	3,480	197,800	220,768
Leeds	1,169	104	2,011	12 11	8 11	174	32,732	5,845	317,028	355,605
Otley and Keighley	73	68	313	7 10	5 1	99	2,044	365	57,123	59,532
Skipton, Sedbergh, and Settle	107	25	138	4 4	4 4	64	2,996	535	32,704	36,235
Selby, Goole, and Pontefract	181	44	451	7 2	0 8	13	5,068	905	7,644	13,617
Doncaster and Thorne	194	59	279	3 10	1 10	36	5,432	970	19,620	26,022
Total	4,334	528	9,853	..	..	..	121,352	21,670	1,279,298	1,422,320
Average	..	..	..	10 9	6 10	133	..	..	..	..

YORK EAST RIDING.

REGISTRATION DISTRICTS.	Average Age at Death of all who Died.	Average Age at Death of all who Died above 20	Proportion per Cent. of Deaths to Total Deaths												Proportion per Cent. of Deaths to Births.	
			Under				Between							90 and upwards	Under	
			1 Year.	5 Years.	15 Years.	20 Years.	20–30	30–40	40–50	50–60	60–70	70–80	80–90		1 Year.	5 Years.
	Yrs. Mths.	Yrs. Mths.														
Howden and Skirlaugh	31 6	57 2	23·3	35·3	44·4	48·6	8·6	6·2	5·0	5·4	6·8	11·4	7·0	1·0	15·1	22·9
Hull	28 0	54 5	24·6	42·8	48·8	51·2	7·0	6·8	7·2	5·6	8·7	9·5	3·2	0·7	26·7	46·4
Sculcoates	25 11	55 10	28·2	46·5	54·2	56·3	7·6	6·0	4·1	3·8	8·0	9·1	4·5	0·6	20·0	33·0
Patrington, Beverley, Driffield, and Bridlington.	28 0	56 7	23·6	41·8	50·3	51·1	7·5	5·5	4·1	5·6	8·1	8·8	5·4	0·9	17·6	31·1
Pocklington and Tadcaster	35 2	59 3	19·9	32·6	39·0	43·6	8·2	6·4	5·0	5·7	7·3	14·0	8·7	1·1	12·7	20·8
York	35 9	56 9	22·9	31·3	36·3	39·2	7·3	7·9	7·9	7·5	10·8	11·3	7·3	0·8	17·3	23·5
Average	30 2	56 5	25·8	39·2	46·2	49·5	7·5	6·4	5·6	5·6	8·5	10·3	5·6	0·8	18·4	30·1
Total number of Deaths	..	..	1,363	2,226	2,625	2,809	428	366	320	321	483	583	320	46	..	..

		Extreme Districts.	
		Pocklington.	Hull.
Total Number of Adults prematurely dying	1,435		
,, ,, to every 10,000 of the Population	60	47	78
Number of all Classes dying from Epidemic, Endemic, and Contagious Diseases	1,155		
,, to every 10,000 of the Population	48	34	57
Deaths of all Classes from diseases of the Respiratory Organs	1,193		
,, to every 10,000 of the Population	50	43	67

Excess beyond the Loss of Life experienced at Pocklington and Tadcaster preventible in each District.

REGISTRATION DISTRICTS.	Excess in Number of			Years' loss of Life to		Total Loss of Money Value of Productive Labour, at 10s. per week Men, and 5s. per week Women; say 7s. 6d. to each Adult Individual.	Total Loss on the Years' Deaths in			
	All Deaths.	Deaths of Adults.	Births.	Every Individual.	Every Adult.		Sickness.	Funerals.	Labour.	Total.
				Yrs. Mths.	Yrs. Mths.	£.	£.	£.	£.	£.
Howden and Skirlaugh	56	7	78	3 8	2 1	41	1,568	280	10,209	12,057
Hull	449	161	84	7 2	4 10	94	12,572	2,245	55,272	70,089
Sculcoates	270	33	227	9 3	3 5	67	7,560	1,350	27,403	36,313
Patrington, Beverley, Driffield, and Bridlington	308	30	181	7 2	2 8	52	8,624	1,540	32,604	42,768
York	160	135	3	..	2 6	49	4,480	800	30,919	36,199
Total	1,243	366	455	..	..	..	34,804	6,215	156,407	197,426
Average. . . .	..	..	..	5 7	3 2	62	..	..	..	..

YORK NORTH RIDING.

REGISTRATION DISTRICTS.	Average Age at Death of all who Died.	Average Age at Death of all who Died above 20	Proportion per Cent. of Deaths to Total Deaths.												Proportion per Cent. of Deaths to Births.	
			Under				Between							90 and upwards	Under	
			1 Year.	5 Years.	15 Years.	20. Years.	20–30	30–40	40–50	50–60	60–70	70–80	80–90		1 Year	5 Years.
	Yrs. Mths.	Yrs. Mths.														
Easingwold, Malton, Helmsley, and Pickering	37 9	57 0	18·2	28·6	35·5	38·2	9·3	6·2	5·3	6·6	11·3	12·8	8·9	1·4	10·3	16·1
Scarborough	37 4	57 8	18·5	28·5	31·8	38·1	7·0	7·5	7·0	9·1	10·3	12·9	6·8	1·4	11·6	17·9
Whitby, Guisborough, and Stokesley . . .	42 1	61 7	17·2	25·9	30·5	33·6	6·4	7·3	6·0	7·1	11·3	13·8	12·2	2·2	10·1	15·2
Northallerton, Thirsk, Leyburn, Richmond, Askrigg, Reeth, and Bedale	39 0	60 4	16·3	27·0	34·5	38·1	9·0	5·2	5·5	7·3	9·1	12·7	10·6	2·3	9·9	16·5
Average .	39 1	59 10	17·3	27·4	33·9	37·2	8·3	6·2	5·8	7·3	10·4	13·0	10·0	1·9	10·3	16·8
Total Number of Deaths	..	..	592	938	1,159	1,273	283	213	197	250	355	445	341	66	..	..

		Extreme Districts.	
		Whitby.	Scarborough.
Total Number of Adults prematurely dying	943	192	131
,, ,, to every 10,000 of the Population	51	48	61
Number of all Classes dying from Epidemic, Endemic, and Contagious Diseases .	438	63	50
,, to every 10,000 of the Population	24	16	23
Deaths of all Classes from Diseases of the Respiratory Organs	717	158	75
,, to every 10,000 of the Population	38	40	35

Excess beyond the Loss of Life experienced at Whitby, Gainsborough, and Stokesley, preventible in each District.

REGISTRATION DISTRICTS.	Excess in Number of			Years' Loss of Life to		Total Loss of Money Value of Productive Labour, at 10s. per week Men, and 5s. per week Women; say 7s. 6d. to each Adult Individual.	Total Loss on the Years' Deaths in			
	All Deaths.	Deaths of Adults.	Births.	Every Individual.	Every Adult.		Sickness.	Funerals.	Labour.	Total.
				Yrs. Mnths.	Yrs. Mnths.	£.	£.	£.	£.	£.
Easingwold, Malton, Helmsley, and Pickering	..	47*	70	4 4	4 7	89	..	..	55,002	55,002
Scarborough	44	19	33	4 9	3 11	76	1,232	220	20,140	21,592
Northallerton, Thirsk, Leyburn, Richmond, Ascrigg, Reeth, and Bedale .	26	42*	45*	3 1	1 3	24	728	130	19,008	19,866
Total	70	79*	58*	..	..	..	1,960	350	94,150	94,460
Average	..	..	..	3 9	2 3	44	..	..	..	..

* Diminution.

On the APPLICATION of SEWER-WATER to the purposes of AGRICULTURE, with a view to the establishment of an independent Income for the Improvement of Towns.

BY JAMES SMITH, ESQ., of Deanston.

THE greatest obstruction to the improvement of towns, as regards their sanatory condition, is the difficulty of finding money to accomplish the necessary works. The only existing mode of raising money for such purpose is by a rate upon the inhabitants: rates are, under any circumstances, unpopular; and more especially so when made for a purpose the advantages of which are not generally understood, or which do not come at once as an appreciable advantage to each individual. The popular feeling against rates has a constant tendency to obstruct improvement. If, therefore, a source can be found from which a sufficient supply of money can be obtained for carrying out, in the most complete manner, all the necessary works for promoting the health and comfort of the people altogether independent of rates, one of the greatest boons to large towns, and, indeed, to all towns, will have been accomplished. I shall, with that view, endeavour to show, that in the profitable application of the sewer-water of every town, there is that source of independent income so much to be desired.

In the sewer-water of all towns, whether running upon the surface in open channels, or finding its way to the nearest brook or river in covered conduits, there must be a large amount of the *débris* of the great mass of matter, which is constantly being carried from the country, to sustain as well the inhabitants as the various animals kept in every town; and this *débris*, being of animal and vegetable origin, must be well fitted to be applied to the land as a manure: reasoning with very ordinary intelligence would at once lead to this general conclusion; but, by the aid of chemical science employed in conjunction with the physiological discoveries of late so clearly laid before the world by Liebig, Boussingault, Sprengel, Johnston, and others, we are enabled to ascertain the particular amount, and to appreciate the pecuniary value of such manure. Independent, however, of scientific inquiry, we have some important practical examples of the great value of sewer-water applied as a manure.

The sewer-water of some sections of the city of Edinburgh has been applied, for upwards of 30 years, in irrigating land of various qualities, for the purpose of promoting the growth of grass, which is cut and used as house-food for horses and cattle, consisting chiefly of milk cows. The sewer-water coming from a section of the Old Town, is discharged into a natural channel or brook, at the base of the sloping site of the town, at sufficient height above a large tract of ground extending towards the sea to admit of its being flowed by gravitation over a surface of several hundred acres. The water, as it comes from the sewers, is received into ponds, where it is allowed to settle and deposit the gross and less buoyant matter which is carried along by the water whilst it flows on a steep descent. From these tanks or settling ponds the sewer-water flows off at the surface, at the opposite end to its entrance. The water so flowing off still holds in suspension a large quantity of light flocculent matter, together with the more minute *débris* of the various matters falling into the sewers, and chiefly of vegetable and animal origin. The water is made to flow over plats or plateaus of ground, formed of even surface, so that the water shall flow as equally as possible over the whole, with various declinations, according to circumstances; and it is found in practice, that the flow of water can easily be adjusted to suit the declination. The land nearest the source is generally a strong loam, on a clay subsoil: as the land extends towards the sea the soil becomes lighter, until at the beach, where it is altogether a pure sea sand, without any appreciable amount of earthy matter. This sand, in its original state, carried but a few scattered patches of stunted whins, intermixed with bent grass. When the irrigation of the sewer-water was first applied to the land nearest to Edinburgh, it was simply allowed to run over the surface in the usual mode of irrigation; but, after the introduction of thorough draining, the beneficial effects of such drainage on arrable land and pasture, suggested to the late Mr. Oliver, of Lochend, one of the tenants of the irrigated meadows, the propriety of having under-drainage in the irrigated ground; and he found, as he had anticipated, great advantage from it, as it permitted the water to percolate through the soil to a considerable depth, thereby diffusing its enriching ingredients through the whole body of the active soil, and even into the subsoil. Thus at present a great proportion of the water thrown upon the land passes through the soil by filtration, whilst only a part now flows off from the surface. As the water flows from each successive plat it is received into an open channel, whereby it is conducted to a succeeding plat, at a lower level, until having passed over a great number, it reaches the sea, and is then lost, though still rich in fertilizing matter, as the following analyses of water, taken from the different stages of its progress, will abundantly show.

Analyses made by Mr. Phillips, the Government chemist, at the Museum of Economic Geology, namely:—

No. 1. Water taken up immediately on its leaving the sewer.
No. 2. Taken as it flowed from the subsidence pond.
No. 3. Taken after having flowed over one plat.
No. 4. Taken after having flowed over several plats.
No. 5. Taken still further on.
No. 6. Taken at the sea.

The analyses stand thus:—

	Solid Matter, in Suspension.	Solid Matter, in Solution.	Sulphuretted Hydrogen Gas.
The gallon of No. 1 gave	244 grains.	82·7 grains.	20·4 cubic inches.
,, 2 ,,	52 ,,	87 ,,	10·4 ,,
,, 3 ,,	31 ,,	89 ,,	11·8 ,,
,, 4 ,,	15 ,,	82·7 ,,	9·2 ,,
,, 5 ,,	2½ ,,	67·2 ,,	11·4 ,,
,, 6 ,,	2½ ,,	72·9 ,,	1·1 ,,

From these analyses it will, in the first place, be observed, that a large deposit of the matter held in suspension takes place in the pond, and that there is also in the first plat of ground a similar deposit of considerable amount; but, as the water advances, passing over successive plate, the deposit diminishes, until there is eventually little left in suspension. On looking to the column in which the matter held in solution is given, it will be found that the proportion of the fertilizing matter in solution rather increases after the first application, and is sustained with very little diminution to the end. The reason of this is obvious: the matter being in solution can only be left in the soil in association with a corresponding portion of water; the other water not absorbed passing off with its own portion of matter still in solution. The matter in suspension in the portion of water taken for analysis differs in some degree from the deposit made on the large scale in the pond, for in the latter there would be a proportion of large pieces of various substances not sufficiently disintegrated to be suspended, but which are rolled along on the bottom of the channel by the force of the stream. The matter which is deposited in the ponds is found to be of comparatively little value, being composed chiefly of cinders and other undecomposable substances. The matter of deposit thus obtained does not sell for more than 1s. per ton, and its value, when compared with the results of the irrigation by the water which has left, is not more than one-tenth of the value of the latter. I may here remark that I observed on going over the meadows so irrigated with the sewer-water, that the offensive smells complained of by some of the neighbouring inhabitants as arising from the meadows, emanated mainly from the masses of decomposing matter left in the ponds, and not so much, if at all, from the water holding only fertilizing matter in solution.*

The practical result of this application of sewer-water is, that land which let formerly at from 40*s.* to 6*l.* per Scotch acre, is now let annually at from 30*l.* to 40*l.*, and that poor sandy land on the sea shore, which might be worth 2*s.* 6*d.* per acre, lets at an annual rent of from 15*l.* to 20*l.* That which is nearest the city brings the higher rent chiefly, because it is near and more accessible to the points where the grass is consumed, but also partly from the better natural quality of the land. The average value of the land, irrespective of the sewer-water application, may be taken at 3*l.* per imperial acre, and the average rent of the irrigated land at 30*l.*, making a difference of 27*l.*; but 2*l.* may be deducted as the cost of management, leaving 25*l.* per acre of clear annual income due to the sewer-water.

In making an application of the whole sewer-water of a town, so great a proportionate annual income could not be obtained as has resulted from the application of small portions, as the difficulty and expense of conveying it to a distance would require a greater expenditure of money in the apparatus necessary to accomplish that object, whilst the value of the produce resulting from the application would be diminished by its greater distance from the locality of consumption. A demand for grass grown by the application of sewer-water in irrigation has a limit which would compel the application of the greater portion to the enrichment of tillage lands, the results of which have not hitherto been found so profitable as those from grass lands. The water could not well be distributed over the open tillage land by irrigation; it would therefore be necessary to resort to some mode of distributing it by jet. This requires the conveyance of the water in pipes, under a pressure of from 100 to 150 feet of altitude, to a number of convenient points in the different farms where it is to be used. In this there is no difficulty; it is a simple engineering question, the success of which is certain, whilst the cost can be estimated on known data. I made an experiment, on a large scale, at the Southwark Water Works, which satisfied me of the practicability of distribution by the jet. With an altitudinal pressure of 120 feet of water, and using a $2\frac{1}{2}$-inch hose with a discharging orifice or nozzle of 1 inch in diameter, I found that I could, from one point, distribute water over an area of two statute acres —but, to be safe, say one statute acre. Dividing the quantity so required annually into three portions, for separate applications, one jet of 1 inch orifice will deliver each portion in about an hour, as ascertained from data founded on an experiment made the same day to ascertain the quantity of water discharged in a given time from a similar orifice, with a similar pressure.

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* Mr. Chadwick and Dr. Arnott, when they went over the irrigated meadows, I am informed, made the same observation.

The sites of most towns, or, at all events, the points of discharge of the sewer-water, being at a lower level than the surrounding country, it will in most situations be necessary to pump the sewer-water to altitudes corresponding to the different altitudes of the lands to be supplied, and with an aditional altitude of from 100 to 150 feet, for the purpose of affording the necessary force of jet. This can easily be accomplished by proper pumping engines, and at one or more lifts, as may be found necessary.* The cost of pumping is matter of calculation, depending in some degree on the cost of fuel when water-power cannot be obtained. The extreme cheapness of the cost of pumping water has been given in the evidence before the Commission; but, in order to found the estimate entirely upon practical result, I have taken the data from a result of three years' actual working, kindly furnished by Mr. Bull, of the Calder and Hebble Navigation, from the returns of an engine pumping water from the brook near Halifax to supply the canal; and I take these data with the more confidence, because the water so pumped consisted chiefly of the sewer-water of the town of Halifax. The engines being old, are not of the most improved construction for pumping, and the assumed quantity to be pumped is taken under the quantity which the engines, in Mr. Bull's opinion, can accomplish. I assume 200 feet as an average altitude. A great proportion of the

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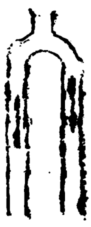
* An erroneous notion has gone out relative to the stand-pipe for giving the altitudinal pressure for the jet. In my first public announcement of the jet plan for distributing liquid manure, I used the expression, "tower, with a cistern at the top," as I thought that expression would best convey a notion of the erection necessary to the gentlemen and farmers who heard me; but I find that some have apprehended a large and boardly tower, with a cistern of considerable dimensions, like a great tank, at the top. Now, all that is necessary is a double stand-pipe of cast iron, of the same diameter as the main pipe standing near the site of the engine, to the necessary altitude say to 120 or 150 feet, and which pipe may be steadied and supported from the engine chimney. The pipe will be at the top thus: up the one branch flows the water from the pump, and which, passing down the other, flows off by the main to the service-pipes. The water having to pass over the turn at the top of the stand-pipe, the pressure will be kept up at all times whilst the engine is at work, and it must always be at work when water is being used.



water of most towns can be disposed of at from 50 to 100 feet, and will seldom be required to be raised more than 400 feet. Part of the altitude will be necessarily expended in overcoming the friction of the conveyance pipes, which will, of course, increase with the distance. In making the following estimate, I have confined the district to be supplied to an area of four square miles, containing 2560 statute acres. I have supposed the whole to be laid off in 10-acre fields, and have put down the position for the service-pipes in such order as to effect the distribution of the water over each area of 40 acres by a hose-pipe 312 yards long. The main piping I have assumed at the length of the side of the square, with one mile added to clear the suburbs of the town. The main is taken at 12 inches in diameter, which will be sufficient to pass the quantity of water required for a great extent of land; and the service-pipes are taken at 4 inches diameter, which is very ample, as never more than two or three jets will be playing from one service-pipe at the same time. The main-pipes I have estimated as of cast-iron, the service-pipes as of fire clay, as I have ascertained that such can be had at one-third of the price of cast-iron pipes, and I have seen such proved to a pressure of 600 feet. They will certainly stand well a pressure of 300 feet. These pipes I suppose to be sunk two feet under the surface, with a plug-opening for attaching the hose for each four fields or 40 acres. The hose-pipe and jet must in all cases be worked by persons employed by the sewer-water establishment, who will apply the liquid at such times, in such manner, and in such quantity as the farmer shall desire, under proper regulations. Part may be delivered by jet, part for purposes of irrigation; and it is evident that any farmer would be greatly benefited by appropriating a portion of his farm as meadow, to be irrigated by the sewer-water for the production of early and abundant crops of grass. The application to the tillage land could be made at any time, on bare fallow or on growing crops; and it is probable that two or more applications in the course of the season, of limited quantities, would be found most conducive to the luxuriant and perfect growth of the crops. Experience will in due time point out the best modes of application. The quantities to be given I have assumed from an analysis showing the amount of fertilizing matter in the sewer-water of Edinburgh and Leeds, as analysed, the former by Mr. Phillips, and the latter by Mr. West, of Leeds; and, making an approximate comparison with guano of the best quality, assuming 2½ cwt. of guano to be equal to 5 cwt. of the fertilizing matter of sewer-water. 2½ cwt. of guano, applied annually to an acre of land, would induce a very rich condition of the soil, especially when conjoined with the farm-yard manure always available, and would even tend, in a course of years, to increase very much the amount of this description of manure. Taking the quantity of water necessary, from analyses, to furnish 5 cwt. of fertilizing matter, at 17,920 gallons per acre, I give below an estimate of the cost thereof; I give also an estimate of the cost of supplying double that quantity, equal to 5 cwt. per acre of guano, or 30 tons of farm-yard manure.*

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* By an experiment made last season, on a portion of meadow in Lancashire, applying at the rate of 15 tons of farm-yard manure per acre, and 3 cwt. of guano to another equal portion, their effects were found to be inferior to the 8 tons of sewer-

Estimate of the probable Expense of Receiving-Tanks, Pumping-Engine, Pipes, Hose, &c., for raising, conveying, and distributing Sewer-Water over an area of Four Square Miles (equal to 2560 acres).

	£.	s.	d.
Receiving-tanks or ponds	500	0	0
30-horse pumping-engine, engine-house, chimney, &c.	2,000	0	0
*Three miles of 12-inch main-pipe	3,704	0	0
Sixteen miles of fire-clay service-pipes	2,020	6	4
Hose with screw joints	283	4	0
Plug-cocks	128	0	0
	8,635	10	4
Contingencies, 10 per cent.	863	11	2
Outlay for 2,560 acres	£9,499	1	6

For one acre, 3*l.* 14*s.* 2*d.*

Estimate of the probable Annual Expense of the Application of 17,920 gallons of Sewer-Water per Acre, which will contain 5 cwts. of dissolved and suspended matter, and which is considered to be equal to a dressing with 2½ cwt. of guano, or 15 tons of farm-yard manure.

	£.	s.	d.
Raising 45,875,200 gallons 200 feet high, to be distributed over 2,560 acres, allowing 17,920 gallons per acre, at 2*d.* per 2,400 gallons	159	15	1
Annual wear of hose	93	12	0
Management, and wages of men employed in distributing	348	0	0
Rates and taxes	320	0	0
Interest on sunk capital 9,499*l.* 1*s.* 6*d.*, at 5 per cent.	474	19	0
Allow for repairs and sinking-fund 2½ per cent. on outlay	237	9	6
Annual expense of application to 2,560 acres	1,633	15	7

	£.	s.	d.
Cost of manuring one acre with sewer-water	0	12	9
" " guano, 2½ cwt., at 8*s.*	1	0	0
" " farm-yard manure, 15 tons, at 4*s.*	3	0	0
Sewer-water is cheaper than guano	0	7	3
" " farm-yard manure	2	7	3
" " the average of the two	1	7	3

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water applied to a similar extent of ground. The water applied not having been analysed, I cannot estimate the amount of fertilizing matters contained in it; but assuming a similar quantity to that found in the Edinburgh sewer-water, the amount applied must have been about 1792 gallons per acre, which is much less than the quantity I proposed to apply to tillage land.

* One-half of the cost of the main-pipe is only charged, as from its position and capacity it is sufficient to supply other sections of land of equal extent.

ESTIMATE of the probable Annual expense of the application of 35,840 gallons of Sewer-Water per acre, which will contain 10 cwt. of fertilizing matter, and which is considered equal to a dressing with 5 cwt. of guano, or 30 tons of farm-yard manure.

	£.	s.	d.
Raising 91,750,400 gallons of sewer-water, to be applied to 2,560 acres, at 2*d*. per 2,400 gallons	319	10	2
Annual wear of hose	140	8	0
Management and wages of men employed in distributing	396	0	0
Rates and taxes	500	0	0
Interest on sunk capital at 5 per cent. . . .	474	19	0
Repairs and sinking-fund, 3 per cent. on outlay	284	19	6
Annual expense of the application to 2,560 acres	£2,115	16	8

	£.	s.	d.
Cost of manuring one acre with sewer-water . .	0	16	6
,, with guano, 5 cwt. at 8*s*. . .	2	0	0
,, with farm-yard manure, 30 tons at 4*s*.	6	0	0
Sewer-water is cheaper than guano	1	3	6
,, ,, farm-yard manure .	5	3	6
,, ,, the average of the two	3	3	6

I have ascertained that the quantity of sewer-water due to a town of 50,000 inhabitants amounts to about 1,190,080,946 gallons per annum, which quantity will yield an annual application of 17,920 gallons per acre to an extent of 66,410 acres. Taking the average cost of guano and farm-yard manure, as shown in the first and lowest estimate, at 2*l*. per acre, and deducting 12*s*. 9*d*., the cost of the application of the sewer-water, there will appear a saving due to the sewer-water of 1*l*. 7*s*. 3*d*. per acre; allowing one-half thereof to go to the farmer, there will remain a free income due to the sewer-water of 45,241*l*., which is nearly one pound per head of the population.

This result is so far corroborated by the estimates given by Liebig, and other chemists, of the value of the solid and liquid excreta of a man. But here there is, in addition in the sewer-water, a vast amount of soap-suds, dish-washings, horse and cow urine, the *débris* from manufactures, the washings of the streets, &c. At present in most towns much of the human excreta, both solid and liquid, passes off into dung-pits, &c.; but a more perfect system of sewerage would secure the whole of the liquid and dissolvable *débris* made within the town so as to cause a much greater enrichment of the sewer-water than exists at present anywhere, or than was found in the sewer-water analyzed to afford data for this estimate.

Taking a general view of the subject, we may safely assume a clear revenue from the sewer-water of all towns of 1*l*. for each inhabitant, either in a direct money return, or partly to the inhabitants in a reduced price from the increased abundance of produce: and it is obvious that such income annually accruing will provide a sufficient fund for the improvement of all towns in a manner corresponding to the most enlightened views with respect to sanatory regulation and improvement of the present time, and will remain as a source for accomplishing such further improvements as science and practical experience shall from time to time suggest.

Obstacles, both moral and physical, will no doubt be found in the way, but none certainly more formidable than such as were opposed to the introduction of gas for lighting towns. At present the sewer-water of towns is unappropriated, and, although all contribute to its production, none claim therein a right of property. It is in principle and in origin public property, and, having an important value, it becomes the duty of the guardians of the public interests to take steps, in the first place, for the investment of all sewer-water for the public interest, and thereafter to provide legal facilities for rendering it practically available. Some time will elapse before the public in general see and fully appreciate the merits of this scheme, and no great heed will be given to it, until at least one town, or section of a town, shall have put the plan into actual operation;* but so soon as that shall have been accomplished there will be a general desire to adopt the plan, and there will be no difficulty in finding ample capital for the purpose. The great outlets of the sewerage of most towns can with little difficulty be adapted to the appropriation of the sewer-water for agricultural purposes, and the internal and more minute sewerage can afterwards be carried to comparative perfection by the funds which will arise from such appropriation.

With such command of funds as the application of the sewer-water will afford, the structural improvement of towns will proceed with a steady progress unfettered by private interests, and uninfluenced by popular clamour.

COPY of a COMMISSION issued in the Reign of HENRY the FOURTH, for INQUIRING into the MEANS of DRAINING and SUPPLYING the TOWN of KINGSTON-UPON-HULL with WATER. *Inquisition ad quod Damnum.* 8 Hen. IV.

HENRY, by the grace of God, King of England and France, and Lord of Ireland, to our chosen and faithful Henry de Percy le Fitz, Esquire; William Gascoigne, Esquire; Peter de Bukton, Esquire; John Scrop, Esquire; Robert de Hilton, Esquire; John Rouche, Esquire; John Holtrum, Esquire; Robert Tirwhit, William Lodyngton, Hugh Arderne, John de Predenesse, and Richard Tirwhit, greeting: Know ye that whereas, as we have learned, our chosen lieges the mayor, bailiffs, and commonalty of our town of Kingston-upon-Hull, hold the same town of us at a fee farm of sixty and ten pounds per annum, and that town is situated upon the river Humber, which is an arm of the sea: and there is need in these days of great charges and expenses for the protection of the same against the force of the water aforesaid: and so as well on account of charges and expenses of this kind there daily arising, to be sustained and supported, as that sweet water is not had coming or flowing to that town, except only by boats, and that at sumptuous cost, whereby the poor inhabitants of the town aforesaid in large numbers every year during the summer time, of necessity, on account of the scarcity and dearness of water of this kind, depart from the same town and renounce and avoid it, to the injury of the town aforesaid, and in process of time to the final destruction of the same, unless a suitable and speedy remedy in this matter be speedily applied. We, considering the aforesaid, and that the said town is the key of the country there adjacent, and of all the county of York, and desiring therefore to treat with gracious favour the aforesaid mayor, bailiffs, and commonalty in this matter, at the petition of the mayor, bailiffs, and commonalty themselves, have assigned you, eleven, ten, nine, eight, seven, six, five, four, and three of you, of whom we desire some one of you (you the aforesaid Henry, William, Robert Tirwhit, William and Hugh, to be one) to inform yourselves by all legitimate and honest ways and means by which, according to your sound discretions you shall best have known how or be able, and also to make inquiry if it shall be necessary, upon the oath of good and lawful men of the county aforesaid, as well within as without the liberties, through whom the truth of the matter shall be able to be ascertained, how and in what manner the said town the better, the more speedily, and the more effectually shall be able to be relieved and sustained with sweet water of this kind, through parts there contiguous and adjacent, as well by sewer courses as by other mode; and to the full and due execution of all and of each (of the things) which shall happen to be devised in this matter, through information of this sort, or by inquiries, by you eleven, ten, nine, eight, seven, six, five, four, or three of you (of whom we desire some one of you, you the aforesaid William, Robert Tirwhit, William and Hugh, to be one) to be duly taken to be ordered, made and completed in the best and most discreet manner which you shall know or be able. And further to inquire by the oath of good and lawful men of the same county, as well within as without the liberties through whom the truth of the matter shall be better able to be known, whether the aforesaid matter to be ordered, made, and completed in this business, by you eleven, ten, nine, eight, seven, six, five, four, and three of you (of whom we desire some one of you, you the aforesaid Henry, William, Robert Tirwhit, William and Hugh, to be one) when they shall have been so ordered, made, and completed, be to our loss or prejudice, or (to the loss or prejudice) of others, or not; and if it be so, then what our loss and what our damage, and to what the loss and what the damage of others, and of whom, and how, and in what manner. And therefore we command you that at certain days and places which you eleven, ten, nine, eight, seven, six, five, four, or three of you (of whom, we desire some one of you, you the aforesaid Henry, William, Robert Tirwhit, William and Hugh, to be one) shall have provided for this purpose, you diligently attend respecting the aforesaid matters, and cause them to be inquired into, and examine them, and send without delay to us in our Court of Chancery, and this briefly, the inquisitions thence distinctly and openly made under the seals of you eleven, ten, nine, eight, seven, six, five, four, or three of you the aforesaid (of whom we desire some one of you, you the aforesaid Henry William, Robert Tirwhit, William and Hugh, to be one) and under the seals of these, through whom they shall have been made. For we have commanded our sheriff of the county aforesaid, at certain days and places, which you eleven, ten, nine, eight, seven, six, five, four, or three of you (of whom we desire some one of you, you the aforesaid Henry, William, Robert Tirwhit, William and Hugh, to be one) may cause him to know, that he cause to come before you eleven, ten, nine, eight, seven, six, five, four, or three of you (of whom we desire some one of you, you the aforesaid Henry, William, Robert Tirwhit, William and Hugh, to be one) so many and such good and lawful men of his bailiewick, as well within as without the liberties, through whom the truth of the business in the aforesaid matters shall be able the better to be known and inquired into. In testimony of which thing we have caused these other letters to be made patent. Witness me myself at Westminster, the Eighth day of March, in the Second year of our Reign.

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* I am at present engaged by the Harbour Commissioners of Aberdeen to report upon the best means of applying the sewer-water of that city for agricultural purposes.

By the King himself and Council,

GAUNSTEDE.

(Here follows the Return of the Inquisition of the Jury.)

INDORSED.

The Answer of John Scrop, Esquire, and of his Fellow Commissioners within written, appears in an Inquisition and Verdicts.—(Sewed to this Commission.)

WE, John Scrop, Hugh Arden, John Redeves, Richard Tirwhit, and our Associates, Commissioners of the Lord the King, being assigned by his letters patent to arrange, effect, and determine how in what manner the town of Kingston-upon-Hull shall be able to be better more speedily, and effectually relieved and sustained with sweet water, as well by sewer courses as by other mode, according to the force, form, and effect of the said letters to us, the aforesaid Commissioners directed, as in the same letters patent more fully appears; by virtue of which aforesaid letters, indeed, by good deliberation previously had. Also through the information, assent and consent of the parts adjacent, and of very many trustworthy persons, we have, for our decision decreed, ordained, and determined that a certain ditch named a sewer constructed anew in the pasture meadows and ground of Aulaby, in breath 12 feet, and of the depth of 5 feet measured by the royal yard, in length from the spring called Julianswell, in the said pasture meadows and ground of Aulaby, as far as the Waldkerr of Swanland, and so descending from the Waldkerr aforesaid, in the length, breadth, and depth aforesaid, as far as Mitonker dike, and so descending by Mitonker dike, on the north part of the field of Mitonker, as far as a certain ditch newly made near the common road which leads from the aforesaid town of Kingston, towards Beverley, in length descending as far as the diteh called the Town Dike, under the walls of the said town of Kingston, and so thence descending and by sufficient course, as far as the gate of the said town of Kingston-upon-Hull; and that a sufficient dam for the warding off of the salt water, may be made in the north end of a certain ditch lying between the pasture of Aulaby and the pasture of Swanland, called the Waldkerr, for ever; and another sufficient dam likewise made for the warding off of the salt water at the north end of a certain ditch lying between the pasture of Swanland called the Waldkerr, and a certain pasture called Mitonker, together with all other dams whatever hereafter to be made, wherever it shall appear necessary to the mayor, bailiffs, and commonalty of Kingston-upon-Hull, now and in future, for the preservation of the sweet water aforesaid, and the warding off of all salt waters whatever coming there for ever; and that all the dams aforesaid made or in future to be made there, as well in constructing as in repairing, be made by the aforesaid mayor, bailiffs, and commonalty at their own proper cost, without injury, disturbance, or obstruction of any persons whatever for ever. Through which sewer, indeed so to be newly constructed and afterwards to be called Juliandike, all the courses of the sweet waters as well of the said spring called Julians well as of all other courses of springs in Demynghamynges in Aulaby, together with the course of a certain ditch in Demynghamynges aforesaid, and the Northkerr of Aulaby, together with the courses of two springs existing in Aulaby and Hautempris, namely, from one spring in the ditch formerly (in possession) of Peter de Aulaby in Aulaby, thence descending as far as the aforesaid ditch called Juliandike, and from another spring in the field of Hautempris in the Northwestynges, from thence descending by different courses as far as the aforesaid ditch of Juliandike, may have a direct course in the aforesaid ditch called Juliandike, as is above written of the aforesaid matters, in the support, upholding, and relief of the royal town aforesaid. Moreover, we, the aforesaid Commissioners, according to the tenour, force, form, and effect of the Commission aforesaid, have caused diligent inquiry to be made by means of different inquisitions taken before us, in neighbouring places and parts adjacent, in the presence of tenants making communications on the ground aforesaid, where the ditch aforesaid is ordered to be made, as in the verdicts of the said inquisitions, sealed and stitched to this letter, more fully appears; all which things having been ordered, ordained, determined, and adjudged, and also (as it is said) inquired into by us, the aforesaid Commissioners, the tenants of the ground aforesaid with unanimous assent and consent, have defined and ordained that the aforesaid ditch should be made as well in length and breadth as in depth, according to our order, determination, and decision aforesaid, and the verdict of the inquisition aforesaid. In testimony, indeed, affirmation, and approval of our aforesaid order, determination, and decisions to last for ever, for the improvement of the adjacent county, and the relief and support of the aforesaid royal town, according to the effect of the Commission of the Lord the King, we have affixed our seals to these presents.

Dated the Eighth day of October, in the Third Year of the reign of King Henry the Fourth after the Conquest.

Mr. Joseph Farrar, one of the Secretaries of the Mechanics' Institution, Bradford.

What is your experience of the necessity of provisions for a Building Act, to remedy the evils you have in existence in Bradford?

We should not have had, as we have, instances where streets are built across and stopped up at the ends; of this we have several instances in Bradford. I imagine that the property has been considerably deteriorated, as well as the health of the inhabitants, from that circumstance. Another evil we should have avoided, and the houses would

have been properly drained; I think there ought to be some compulsory powers, for the protection of the tenantry, to have the slop-drains run into the main sewers.

Would the convenience of cheap supplies of water and of water-closets be appreciated by the working classes?

I think the introduction of proper supplies of water into the houses would be appreciated, and would facilitate the improvement of the working classes; but they are not yet generally acquainted with water-closets.

Are there not in Bradford a considerable proportion of married men of improving habits that might adopt any improvements such as those recommended; and if they saw that they were the means of reducing sickness, be willing to pay a little additional for the benefits they would derive from them?

Yes; I think many would, and would voluntarily pay what was necessary.

When the better class of workmen become accustomed to it, would not other inferior classes follow?

I think they would.

Have there been many fires in houses belonging to the working classes?

I think we have had very few fires—only three or four during the last 20 years from tenements of the working classes.

What sort of walls are built for the cottage tenements?

The walls for cottage houses are generally a single brick; in better houses they are thicker. I do not think that in the labouring class tenements it would be necessary to incur the expense of providing party-walls by a legislative Act.

Do many of the labouring classes own houses?

Many of the working classes have built their own cottages: those that have saved perhaps 60*l*. or 70*l*. have purchased land and raised money on mortgages, and then have erected others. In some instances clubs, sustained by monthly payments, have built, and the houses are divided by valuation and lot.

What proportion of labouring class houses are held directly or indirectly by themselves?

I cannot state precisely; probably there might be one-third of the cottage houses owned by the labouring class.

Are there other classes that are wholly dependent on cottage rent?

Yes; I know several who sink all their capital in cottages, and depend on the rent.

It is to be presumed, then, that few could advance money for permanent improvements on the property?

It would on many be a matter of great severity to have any more immediate outlay.

If the money were raised by loan, and payment spread over a period coincident with the benefit—say 20 years—and charged at a rate of 3*s*. or 4*s*. per annum?

It would undoubtedly facilitate the improvement to spread the expenditure over a period of years.

Would it be desirable to enforce better ventilation?

Undoubtedly it would.

Would it receive much opposition?

I think not.

To the COMMISSIONERS for INQUIRING into the SANATORY CONDITION of POPULOUS TOWNS.

GENTLEMEN, *Bradford, Yorkshire, March 22nd,* 1844.

The Bradford Board of Surveyors beg respectfully to offer to you their opinions of what they deem to be the defects in the General Highway Act, and also to point out to you some of the local difficulties they have to contend with in the discharge of their duty.

The present Board of Surveyors, consisting of 13 members, was formed 12 months ago under the 18th section of the Highway Act, previous to which time there were only two surveyors for the whole township. A party of rate-payers alive to the importance of having better regulations in the town, assembled at the vestry and elected the present Board, several of whom have taken a great interest in the good management of the town. The surveyors have divided the town into districts or wards, over each of which two members of the Board are appointed to superintend. They have let the collection of the rate on the per centage system, and have made several other arrangements with the view of carrying out the improvements required in the most efficient and at the same time in the most economical way. Several improvements have already been effected; some are in progress, and others in contemplation. Nevertheless, by the present constitution of the Board, the whole of the surveyors will have to retire from office at the end of the year, and though re-eligible, they are aware that at the ensueing election a stronger party may assemble and elect an entire new Board, who may be either totally ignorant of their duties, or who, being averse to the plans of the present Board, may suspend the improvements now going on, and prevent those that are in contemplation. From the loose wording of the Act, also, it is not clear whether, when a Board is once formed, the vestry shall have power to revert to the old mode of management. To remedy these evils the surveyors think that only a portion of the members of the Board should retire annually. They also think that the election should not be by the vestry, but that they should be elected by the burgesses on the burgess list in corporate towns, or in the same manner and at the same time as the Poor Law Guardians in towns where there is not a corporation. They wish also to remark, that the present Act makes no provision for supplying vacancies in case of the death of any of the surveyors. During the past year two active and efficient members of the Board have died, and for want of such a provision, no others could be appointed in their room.

The Highway Act does not clearly define the powers which the Board of Surveyors have in the appointment or the discharge of some officers, or in the recovery of moneys, books, documents, &c., from any of the officers who may be disposed to retain them. An instance has occurred during the present year when a collector, on being discharged, took away from the office all the rate-books and kept them nearly a month, during which time the business of collecting was at a stand. The magistrates refused to interfere till the Special Highway Sessions were held; and the remedies are so imperfectly defined in the Act, that the Board were doubtful whether they should succeed when the case should be heard. The collector, however, was prevailed on to give up the books after the proceedings had commenced. The surveyors think that the law for such cases ought to be more clearly defined, and that not only for such cases, but for the general purposes of the Act, it should be more summary.

The fees payable to the clerk of the magistrates, according to the 10th section of the Highway Act, are, in the opinion of the surveyors, much too high, and are considered very oppressive to the poorer classes. The cost of a summons is 2*s*., and for a distress warrant 4*s*. Now there are several thousand rate-payers in Bradford whose rates do not amount to more than 2*s*., and when the rate is small, the surveyors are reluctant to summon for fear of the expense. In consequence of this, in such a fluctuating population as that of Bradford, a great many of the rates are lost by the removal of the occupiers before proceedings are commenced. They think that if the fees were less they should be induced to summon more readily when a rate-payer was neglecting to pay, and the rate-payers being aware of this, would become more punctual in their payments. They are of opinion, however, that if the owners of property should pay the rates, or at least the rates of all the property the rent of which is under 10*l*., this evil would be remedied. If a poor person wishes to be excused the payment of his rate by the 32nd section of the Act, he is to summon the surveyor before the magistrates, who, upon hearing the case, have power to excuse the rate. This is the only mode pointed out by the Act, by which a poor person can be excused from the payment of his rate. Thus if a rate-payer owes 1*s*., and wishes to be excused, he must summon the surveyors before the magistrates at a cost of 2*s*.; or the surveyors must summon the rate-payer at the same cost, and then the magistrates may forgive the rate. To remedy this the surveyors think that the Board should have power to excuse the rate of any poor person without the interference of the magistrates at all; or the magistrates might, on the recommendation of the Board, be empowered to excuse such rates.

Local Difficulties.—The Local Act for lighting and watching the town gives the Commissioners, appointed under the Act, power over the causeways and footpaths in such streets as are declared to be within the limits of the Act. The 112th section of the General Highway Act reserves to the Commissioners this power. The effect of these clauses in the respective Acts is this, that a part of the causeways and footpaths are under the control of the Commissioners, and a part of them under the surveyors. From a want of prpper official documents, doubts arise frequently as to which of the two bodies certain parts of the causeway belong. From these clauses another evil has also arisen. Either from the remissness of the Commissioners, or from some defect in the Act, encroachments have been frequently made upon the causeways, and a notion has become prevalent that the causeways are the private property of the owners of the houses. This notion is strengthened by the fact that the owners are compelled to keep the causeways in repair by a clause in the Local Act. Hence posts or railways are put down to preserve, what they conceive their rights, and which are a source of great annoyance and danger to the public. In consequence of this the surveyors find great difficulty in widening the cartway, in rounding the causeways at the corners of the streets, or in laying down or removing causeways to meet the growing requirement of the town. When any such alteration is required, they have first to prevail upon the Commissioners to move in the business; and when they undertake any alteration, the owner of the property adjoining not unfrequently resists them, and thus the town is kept in constant turmoil and litigation. About four months ago the Commissioners commenced an alteration in the causeway of one of the principal streets over which the public had passed during the memory of the oldest inhabitant. Nevertheless the owners of the property adjoining drove off the workmen by main force, and the causeway has remained all the winter in an unfinished state, highly dangerous to the public. To remedy this state of things, the surveyors think that the whole of the street from wall to wall ought to be under the control of the same body, and that the expense of the making and the repairing of the cartways and causeways should be defrayed by the public from the Highway Rate.

The Bradford Canal is supplied with water from the Beck, which for a short distance runs parallel to it. The bed of the Beck is lower than the bed of the Canal, and hence flood-gates or stop-gates are put down in the Beck, which prevent the escape of the water till it rises to a certain level, in order that the Canal may have a supply of water, which is conveyed through a sluice for this purpose. The drains of the town are emptied into this watercourse, and principally above the flood-gates. Besides, on the sides of the stream, there are a great many factories of various kinds of manufacture, &c., the soil, refuse, and filth of which fall into the Beck. In summer time the water is low, and all this filth accumulates for weeks or months above the flood-gates, and emits a most offensive smell. This noxious compound is conveyed through the sluice into the Canal, where it undergoes a process which renders it still more offensive; for the mill-owners below the flood-gates having a deficiency of water, contract with the proprietors of the Canal for a supply of water for their boilers. The water is conveyed for this purpose in pipes to the boilers, and after being used for the generation of steam, is conveyed back again into the Canal, so that the waters of the Canal are scarcely ever cool in summer, and constantly emit the most offensive gases. The public health suffers considerably in consequence in the neighbourhood of the Canal, as it appears from the mortuary returns that more deaths have occurred in this locality than what have occurred in a better conditioned locality. During the last summer the surveyors began to lay down an efficient drain in the principal street (Kirkgate) in the place of the old drain, which was too small for the purpose for which it was intended; and in order to promote the health of the town it was thought expedient to empty the drain into the Beck below the flood-gates. This plan, however, they were for some time prevented from carrying into effect by the Canal Company, on the plea that it was a *diversion of the water to which they were entitled.* The Company ultimately allowed the original plan to be carried out, either because they thought the powers given in their Act were not sufficient to prevent it, or because a consideration for the public health triumphed over private interests. The surveyors think that not only should the flood-gates be removed from the populous neighbourhood where they are, but that they should have the power to empty the drains into whatever part of the Beck they may think best, provided no better receptacle can be found for the filth. They are also of opinion that some general system of efficient drainage should be adopted throughout the whole town.

The Bradford Beck passes through the most populous parts of the town. The stream, as stated above, is the receptacle for the filth of the town, and during the dry season of the year emits very offensive smells. It is liable to swells in rainy weather, and the lower part of the town is inundated. These inundations of late years have become more frequent in consequence of the encroachments made by building either in or over the watercourse, which prevent the ready flow of the water. The owners of the property on either side measure and sell half the bed of the stream, and the purchaser, as a matter of course, thinks he has a right to appropriate this as he thinks fit. During last summer the surveyors were desirous of removing a deposit which had accumulated under one of the bridges, the removal of which would assist the escape of the water and greatly tend to prevent a recurrence of floods; but they were advised that they had no power to interfere in any part of the stream. They are of opinion that they ought to have power to prevent any further encroachments in the bed of the Beck, and also to have power to lower all or any part of the bed, and to flag or pave it if they think proper, so that the water, in times of flood, may escape the more rapidly. It ought to be stated that the registrars after a flood notice an increase of deaths from epidemic disorders in those parts of the town which have been flooded.

Several nuisances exist in different parts of the town; but as they are private property, the surveyors have no powers to interfere to cause their removal. One of these is in the most public part of the town, and in the very centre of business, and consists of refuse, offal, &c., from the butchers' shops, necessaries, ash-places, and urinaries. A part of this locality is unpaved, and in wet weather is nearly ankle deep in mud. This is private property, and therefore the surveyors understand that they cannot cause the removal of these nuisances. There are nuisances of a somewhat similar description in Stoll Hill, near the parish church and the Catholic chapel. The surveyors think that either they or some other public body ought to have power to remove these and similar nuisances in the town.

The factories are numerous in Bradford, and an immense quantity of coal is consumed in their furnaces. The coal consumed is of the worst kind, and contains a great proportion of sulphur. The atmosphere of Bradford and its neighbourhood is constantly impregnated with the smoke arising from these furnaces, and is highly prejudicial to the health of those who inhale it. A clause was inserted in the Local Act, the object of which was to compel the mill-owners to consume their smoke by the erection of apparatus for that purpose. This clause has, however, been found to be inoperative from the loose way in which it is worded. The surveyors think *that* in any Act which may be obtained for the better regulation of Bradford, a clause clearly defined ought to be inserted, making it imperative on the mill-owners to consume the smoke of the furnaces.

The surveyors are of opinion that in the formation of new streets the owners of the ground thrown out for building should be compelled to set out the street open at both ends, and that it should be paved and sewered to the satisfaction of some competent surveyor before any erections are made thereon, and that no new erections should be allowed, unless they have cross drains from them to the main drain. From a want of a provision of this kind the streets in Bradford are built in a most confined manner, and they are unpaved and without drains.

By order of the Board of Surveyors,
(Signed) W. Clough, Clerk.

SHEFFIELD.

Report by Mr. Lee, Inspector of Highways.

Sheffield, Highway Offices, November 28, 1843.

In a report of the inconveniences and expense entailed by management of roads in Sheffield, without system, and under different surveyors, I may refer generally to Dr. Holland's "Vital Statistics of Sheffield," recently published. A few facts, not contained in that work, may be briefly mentioned. One great inconvenience and expense was the expenditure of large sums in the neighbourhoods of the several surveyors, while the principal thoroughfares were comparatively neglected; but the root of this and other evils was the absence of an efficient, independent, permanent, paid officer. My predecessor, who was employed many years, *could neither read nor write.* He kept horses and carts which, under his own superintendence, performed team-work, by the day. He recommended and overlooked the making of common sewers, and at the same time contracted to do the work himself without level, plan, specification, or written agreement, and of course without any regard to the dimensions required in the localities. Within the last eight years, several miles of such sewers have required to be entirely reconstructed, and some are now in the state indicated in the sheet of transverse sections of the older sewers, in Bowling-green-street and Norfolk-street.

Jobbing to a great extent was done with persons who supplied materials and labour; and one surveyor had frequently a large piece of work executed in his own neighbourhood, without even the knowledge of his colleagues, and to complete such work as speedily as possible, any kind of material was used. The form and construction of the street pavements was almost a matter of chance, some carriage-ways having twice the proper convexity, and others being so flat as not to clear themselves of water. The surveyors annually elected accepted the office, ignorant of their proper duties, and when they began to see the evils that existed, and were competent to apply a remedy, their time of office expired, and they were succeeded by others.

No books of the expense of roads and works were kept, and the annual cost of maintaining a certain length of any kind of road was so little known, that the last surveyors, before the passing of the present Highway Act, rendered the public liable to repair for the consideration of 100*l.*; a line of three roads, which have cost annually, since that time, the average sum of 241*l.* 1*s.* 1*d.* In places where the active management is entirely in the hands of the annually appointed surveyors, the expenditure is much greater than necessary, and the roads in a very inferior condition, and the most improper and i g o practices exist. At the annual passing of accounts, in March, tw years since, a surveyor informed me that in his parish statute duty was still performed, and that they had taken no further notice of the present Highway Act than to alter the time of electing surveyors from September to March.

Since the present inquiry was proceeding, I have received a letter from a rate-payer in a neighbouring township, who had read in the public prints the queries put to me by the Commissioner. I communicate it, though anonymous, because it displays the mismanagement inflicted on a populous place, *where there is a Board*, but no responsible permanent surveyor.

Sir, Township of ———

I take the opportunity of addressing a few lines to you, respecting the management of the Board of Highways for ———. It has been the custom for a number of years for men to get into office, to serve their own interests rather than that of the town at large, by expending money where it is not wanted, for the sake of improving their own property, while at the same time a number of other places have altogether been neglected for the want of a proper person to bring those places before the Board.

Proposed improvements have been disapproved of altogether by the present Board, on account of the expense, saying that they wanted to do with one book, while the next that comes into office will be obliged to have from two to three books, to repair certain roads that these parties have neglected, and yet these very gentlemen can always oblige their friends and neighbours with what they may want, by one surveyor saying to another, "you must survey my job, and I will survey yours." By these means they put it out of the assistant surveyor's hands having anything whatever to do with work. One gentleman has brought forward certain streets that want both common sewers and repitching; but because he could not get a majority for it, nothing could be done, where nuisances have been complained of for years, to my knowledge. He has, in consequence of this, refused to act with them any more. Such is the practice and economy of the ——— Board of Highways. Much more might be said, to show that there is a great deal of partiality where there ought to be none.

I remain, &c.,

To Mr. W. Lee. A Ratepayer in the above Township.

The improvements that have been effected in the township of Sheffield, by a more comprehensive system, may be briefly stated:—

I. The reconstruction of several miles of the older sewers.

II. The extension of paved carriage ways; so that from the 25th March, 1836, to the 25th March, 1843, the macadamized roads have been reduced from 52 in number, extending 11¼ miles to 35 extending 7 miles.

III. The generally improved condition of all the public highways in the township; and,

IV. The constantly decreasing annual expenditure, even while such improvements were being effected, the amounts for the last eight years being as follows:—

	£.	s.	d.
1834—5 . . .	9,237	1	2
1836—7 . . .	8,913	9	6½
1837—8 . . .	8,032	5	0½
1838—9 . . .	8,561	15	3½
1839–40 . . .	8,252	4	2
1840—1 . . .	7,906	1	0½
1841—2 . . .	7,534	7	7
1842—3 . . .	7,234	16	11½

There are in reality no legal powers in force to regulate the drainage of towns like Sheffield, and the general Highway Act contains many defects that would be easily pointed out. It is indisputable, that the highway funds are extensively wasted and mismanaged, and that the majority of parishes are too poor singly to pay the salary of an efficient surveyor.

I think, therefore, that the formation of districts should be compulsory, and that such districts should be sufficiently large to secure the whole services of an efficient permanent surveyor, who should possess the qualifications of a civil engineer. Such districts might be identical with the Poor Law Unions, or, what would be better for drainage, might comprise geological areas, containing a large population, without regard to the arbitrary boundary lines of counties and parishes. I have no hesitation in saying, that on the grounds of economy and efficiency, the sewers and the roads ought to be under the management of the same surveyor. That which is best for a part will be good for the whole, and therefore, any improved legislative enactments should secure not only scientific management, but as far as possible UNIFORMITY. If it be objected that an extensive system of artificial drainage would only be required for populous districts, a separate Act might be passed for the paving, cleansing, and draining of city and town districts, and another providing for scientific management of the roads in rural districts.

The spirit of the two Acts would be the same,—the difference only in the practical detail of each.

The qualifications for the office of commissioner, or member of a Board, should be such as to exclude all *jobbing cabals*, and attempts to serve private interests at the expense of the public; and to secure the greatest amount of intelligence and respectability.

The qualification of surveyor should be his scientific attainments, skill, and experience, and an unblemished character. A person should not be a more eligible candidate for the office because he has many friends, but has been unfortunate in some other business.

The respective duties of the Commissioners or Board, and the surveyor of the district should be clearly defined, and no Acts of the former should have any force or virtue, but those of the major part of the members present at a meeting of the body duly convened.

To induce men of talent and integrity to accept the situation of surveyor, the office should be held permanently during good behaviour, such an officer so qualified and faithfully discharging his duty ought to be protected from the unpleasantness of an annual re-election by the Commissioners or Board, when his salary may be reduced, or even his situation be placed in jeopardy, because in the exercise of his public duties he may have rendered himself obnoxious to individuals who have since contrived to get themselves and their friends into office for the purpose of injuring him. The more efficient and talented the officer, the more easily such designs against him succeed, because the ratepayers, satisfied with the previous management (and for the continuance of it, the known character of the officer is a guarantee), become apathetic and indifferent to the election of the Board, and leave its construction to those who have some sinister object to attain. I have dwelt more at length upon the qualifications and duties of the various officers, because it is of little consequence what may be the law, unless it provide that they in whose hands its execution may be placed shall be properly qualified.

Estimates.

For private house drainage, I have no doubt tile-piping would be the best, but I cannot state the exact expense, because they have not been used in Sheffield:—efficient house drainage, whether by tile-pipe, brick, or stone, 4*s.* 6*d.* to 6*s.* per running yard.

Where water-closets are used, the whole of the soil and liquid refuse passes into the sewers through the leaden pipe and a small drain. The charge of the water company, I believe, is 30*s.* per annum for each closet, they might probably be supplied for much less. After the first outlay a *good* water closet will not cost in repairs perhaps more than 5*s.* in eight or ten years; but the ashes or dust would still require moving, and as it is not used here for making bricks, the expense would be per house 5*s.* to 10*s.* annually.

The *cheapest* mode of house cleansing, irrespective of all other considerations, is undoubtedly the present one, (i. e.) privies with ashpits and cesspools emptied, perhaps, twice or thrice during the year by farmers in the neighbourhood, who pay the occupiers of the houses from 1*s.* to 3*s.* per cart-load.

	£.	s.	d.
The cheapest form of closet used here is called the "servants' closet;" it is merely a bason or pot inserted into a pipe or drain, with a tap from the cistern to wash it out occasionally. *It is by no means efficient.* The cost would vary, being greater if fixed upon the first or second floor than upon the ground; much would also depend upon the distance from the sewer. The general average would be :—			

	£.	s.	d.
Plumber . .	4	0	0
Joiner . . .	2	0	0
Mason and drain	2	0	0
	8	0	0

The best and most effective water-closets used here are the various kinds of "pan-closet," but they require the handle to be lifted up every time they are used; and the various "self-acting closets;" either of these kinds would cost under similar circumstances to the above 12 0

N.B.—All closets inferior to the two latter are liable to become filthy and disgusting.

It is somewhat difficult to say what number would be required; but if every house in the densely populated part of the town were to have a separate water-closet, there would be at least 18,000

If the houses in each court had the present privies turned into a common water-closet, with a large cistern over it, the number would probably not exceed 8,000

In the densely populated part of the borough there are probably 40 miles of streets, containing an average of 450 houses per mile; this would give the 18,000 houses stated above; 10 miles may be deducted for sewers already made, leaving 30 miles of new sewers to be constructed, which, at 880*l.* per mile, would cost 26,400*l.* or 27,000*l.*; the average charge per dwelling-house, for main sewers, would therefore be 1*l.* 10*s.*, and the annual instalment for repayment in 30 years of principal and commuted interest, at 5 per cent., would be 1*s.* 9¾*d.* The charges would therefore be as follows:—

First Outlay, per Tenement.				Annual Instalment of Principal and Interest for 30 Years.		
Servants' Closet:—	£.	*s.*	*d.*	*s.*	*d.*	
Water Closet . Cistern . . Drain . . .	8	0	0	9	6¼	
Main Sewer .	1	10	0	1	9¾	
Water . . .	..			..		unknown.
	9	10	0	..		
Pan, or Self-acting Closet:—	£.	*s.*	*d.*	*s.*	*d.*	
Water Closet . Cistern . . . Drain . . .	12	0	0	14	3	
Main Sewer .	1	10	0	1	9¾	
Water . . .	..			..		unknown.
	13	10	0	..		

I have prepared a sheet exhibiting transverse sections of some of the *older sewers.* Several of them are capacious,—none of them are in the best form; some that were laid down only a short time before my appointment are in a ruinous condition, and in any efficient system of drainage, would require to be reconstructed in a better form, and at a lower level.

The cost of bricks for sewers varies according to the size, quality, and other circumstances, for every 1000, from 18*s.* to 24*s.*

The cost of making the same, for every 1000, from 13*s.* to 17*s.*

I have also prepared a sheet of transverse sections of the sewers constructed during the last eight years. Nos. 4, 5, and 6, are not good for cleaning themselves; they are very seldom used, never but when the inclination of the street is great, and then only because they are very cheap. Nos. 7 and 8 are the general forms of grate-soughs or gully-holes; the cost per running foot for each is as follows:—

	s.	*d.*		*s.*	*d.*
No. 1 . .	5	4			
No. 2 . .	4	0	to	4	3
No. 3 . .	3	4	to	3	9
No. 4 . .	2	6			
No. 5 . .	2	2			
No. 6 . .	1	10			
No. 7 . .	1	4			
No. 8 . .	1	0			

The private house drains are generally badly constructed, and as I have in a previous communication informed the Commission, cost from 8*d.* to 1*s.* 9*d.* per foot; the forms of several are given upon the sheets of transverse sections of the older sewers. Owners of property are frequently much imposed upon in price. They might have drains better constructed for the cost of labour and the material only, by our men, *but they prefer making their own bargains.* Applications are seldom made to me respecting drains by the owners of property, excepting to determine disputes between the contractors and themselves, or when the drains are found to be useless.

There is no charge for entrance to public sewers: great injury having been long done to the sewers, and to the street pavements, by unauthorized persons disturbing them. A printed notice has been recently posted in the town; and by the direction of the Board, I have prepared a printed form of permission, a copy of which is attached to that notice.

There are no other public regulations for private drainage.

I have prepared a sheet of transverse sections of the best forms and sizes of drains, and have shown in colours the materials available in the locality. I have no experience to enable me to say whether or not tile-piping for small drains would be cheaper than any other material. *I think it would;* but the public drains could not be well executed, *upon a large scale,* cheaper than at present. The prices per foot lineal would be about as follows:—

	s.	*d.*		*s.*	*d.*
No. 1	6	6	No. 7	1	8
No. 2	4	8	No. 8	1	8
No. 3	4	0	No. 9 probably	1	6
No. 4	3	6	No. 10	1	6
No. 5	3	0	No. 11	1	6
No. 6	2	8	No. 12	1	6

Nos. 7 and 8 are intended for grate-soughs, and Nos. 9, 10, 11, and 12, for courts, houses, and other private drains.

My jurisdiction is confined to the township of Sheffield. There is a separate Board in Ecclesall Bierlow. I believe there are some few sewers there, *but the officers confess they know nothing about them.* If there are any sewers in the other townships, namely, Bright-side, Bierlow, Attercliff-cum-Darnall, Nether Hallam and Upper Hallam, the respective authorities *do not know it.* I have therefore necessarily confined my plans* for the Commissioners to the township of Sheffield.

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* These plans were transmitted to the Commission, but it was not considered necessary to insert them.

The scale upon which they are laid down, is two chains in an inch. The private streets and lanes were generally in a filthy and abominable state until a few months since, when I induced the Board of Guardians to employ a large number of able-bodied paupers in removing the refuse, *and it has not yet had time to accumulate again.* These roads, and all that are *unpaved*, I have coloured GREEN. The public streets are in good condition; but as one mode of repair is more conducive to cleanliness than another, I have distinguished the *macadamized* streets by colouring them PINK; *the boulder pavements*, YELLOW; and the *square stone pavements*, BROWN. All the foot pavements in the streets are curbed and flagged. The BLUE lines show the lines of equal altitudes; the RED lines and lettering, the situations, sizes, and depths of the sewers. The BLUE *spots* represent water-closets; and as all the remaining houses have only common privies, they are sufficiently distinguished without colour.

I am unable to say that there is any street, through which there is a public sewer, entirely without private house drains.

WILLIAM LEE, Assistant Surveyor.

To the Health of Towns Commission.

PLANS generally adopted in the TOWN of SHEFFIELD for COTTAGE HOUSES.

I APPREHEND that no legislative enactment can be made to compel persons to invest capital in the erection of buildings for the use of either rich or poor, unless such an investment is likely to produce a fair return; it would therefore be wasting time to give designs of cottages for the labouring population, unless it can be shown that such cottages can be let to pay fair interest for the capital invested.

Being unacquainted with the exact plans of cottage property in any town but Sheffield (where, by the way, it is generally admitted the lower classes are better off both as to convenience, extent of accommodation, and rent, than in most other towns), I will briefly describe the plans generally adopted. Cottage houses, or common tenements, as they are commonly termed, are built in rows, back to back, one house fronting a street, another fronting an enclosed yard. Each tenement has a cellar, living or day-room on the ground floor, and chamber or garret for sleeping-rooms.

The cellars are drained by a sough running longitudinally under the floors, from thence into a main sewer, or, if there be none (which is frequently the case), into as small a sough carried along the street until the requisite fall is obtained as the owner can make.

The cellar is almost invariably covered over with a brick-arch floor paved, and has an aperture in the foot-path for light and air secured by a cast-iron grate.

The living or day-room is about nine feet high, floor paved with flags. The fire-place is fitted up with an oven to bake bread, &c., and side boiler with a tap for hot water, dished slop-stone with a lead-pipe to carry the waste water into the street channel or sewer, an iron gully to contain 8 or 10 gallons set in brick-work used for brewing, [illegible]ng water for washing, &c.; also a cupboard, besides sundry shelves, &c.

The chamber is from 8 feet to 8½ feet high with boarded floor, has a fire-place and stove-grate. The chamber is made private by a ceiling covering the attic stairs.

The garret is about 7 feet high, and is sometimes fitted up with a fire-place, stove-grate, &c. Formerly many of the cottages had casement windows, but those erected within the last 20 years have generally been fitted up with double sliding sashes. The great superiority of sliding sashes over casement windows for the purpose of ventilation is now so well understood and appreciated that any comment thereon would be superfluous.

The cottages before described, containing, as we have seen, a good cellar, living room, and two private bed-rooms, previous to the great depression of trade, let on an average at 2*s.* 6*d.* per week, or 6*l.* 10*s.* per year, the landlord paying poor-rates and water-rent, the tenant paying highway-rates. The cost of erecting such cottages, including fencing the yard, privies, ash-vault, soughing-yard, and street paving, &c., according to the manner or quality of building, from 60*l.* to 75*l.* each

Gross rent paid by the tenant, 6*l.* 10*s.*

Interest on—say 70*l.*	£0	3	10
Ground rent	0	15	0
Poor-rates and water-rent	1	0	0
Repairs, insurance, and loss by empty-houses, and bad rent	0	10	0
	£5	15	0

So that the landlord cannot expect to get more than 6 or 7 per cent. at furthest on his investment, while his capital is being reduced every year by the gradual dilapidation of such perishable property.

These cottages being constructed with fire-places in, and chimney-flues from, every room in one or more of which a fire is constantly burning during the day-time, thereby rarefying more or less the air in all the flues, with proper attention to the opening of the sashes carries on as complete a system of ventilation as I conceive can be effected without the introduction of complicated machinery, which would, if left to the management of tenants, soon fall into disuse. The only improvement I can suggest in the erection of such cottages would be to make the rooms a little larger and loftier.

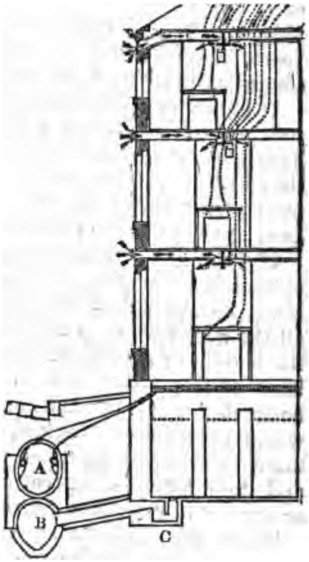
It has been said that cottage-houses ought not to be built back to back, but should have both front and back doors, in order that a current of air might pass through the house to ventilate it; but it must not be forgotten that the lower as well as the upper classes, the strong as well as the weak, suffer from direct draughts or currents of air; and may it not be as necessary, if not more so, for the thinly clad and poorly fed mechanic and his family as for the upper classes who lack neither clothing nor food. Cottages erected on a plan similar to the accompanying sketches are not only built at less cost, but, in my opinion, much warmer and better ventilated than houses having front and back doors with thorough draughts.

After providing a warm, well ventilated, and well arranged cottage for the artisan and his family, the next consideration is drainage. From the want of proper attention to this first essential to the health of towns (affecting, as it does, the health of the poor ill-fed much more than the well-fed) have arisen fevers and a long catalogue of diseases affecting the health and lives of the inhabitants. This has been the plague-spot of our towns and villages. Let all the surface-water be conveyed under ground as soon as may be by well-contrived and spacious common sewers, sunk deep enough to drain all cellars, &c.: compel the introduction of well contrived stench-traps, whenever a communication is made from the cellars into the main sewers, and also to all street-grates, and the hydra-headed monster, fever, is more than half subdued. No matter how numerous or capacious the common sewers may be, unless the foul air generated in them be prevented being drawn therefrom into the cellars and drawn thence by the warmth of the upper rooms amongst the inhabitants of the house, the evil is but half remedied.

The next consideration is the least offensive kind of privies or water-closets. I think the ordinary kind of water-closets not only too expensive but totally unfit for the use of the poorer classes. I may venture (after a good deal of experience in such matters) to say that I am pretty certain if two of the best and strongest kinds of closet, with an abundant supply of water, were put down for the exclusive use of eight or ten cottages, they would not only be out of repair in a fortnight, but useless and a positive nuisance; then what is to be done with children? they could not be taught to use them properly; or, suppose they could, who is to keep them out of mischief. In a large and well-regulated hospital for fever patients situate in a sea-port town that I visited some years ago to examine and report on the method of ventilation, &c., I was told that it was next to impossible to keep the water-closets in order in consequence of the mischievous propensities of persons using them: sometimes they thrust old stockings into the trap, at others spoons, and even knives and forks had been found there. If, however, some simple plan could be adopted not easily put out of order, with a plentiful supply of water, and proper officers, such as policemen, appointed to pay periodical inspection visits, with power to order the closets to be cleansed and repaired, if necessary, and conviction before the magistrates to fine persons for neglect or mischief, under such circumstanses, I think the introduction of well-regulated water-closets instead of open privies and soil-vaults would be a great benefit to those who are under the necessity of living near those conveniences.

I have already given an opinion as to the best method of ventilating cottages during the day-time without the introduction of any artificial means; and although great benefit may be derived by proper ventilation during the day, it is of much greater importance in the night, when the small bed-room of the artisan is occupied by himself, his wife, and, may be, one or two children, containing perhaps not more than 1000 cubit feet of air, the fire-place probably boarded up to keep the room warm, and so prevent ventilation that way; these are the rooms in which the family spend perhaps at least one-third of their lives, not unfrequently breathing the same air over and over again; it is evident, therefore, that if ventilation is of importance anywhere, if must be especially so in a bed-room. So much depends on the inmates of the house using the means provided for the purpose, that to propose a plan which would be generally applicable seems an exceedingly difficult task; persons, especially poor persons, like to be warm and comfortable when they go to sleep;

thinking nothing of the bad effects of breathing over and over again a vitiated atmosphere, they close up every place that may let in air; at this we cannot be surprised, especially if the air comes in draughts. The grand object to be gained is the ingress of fresh air in moderate quantities, not in currents, but contrived that it may spread all over the room so gradually as not to be perceptible to the inmates. I have introduced a plan of supplying the day and bed-rooms of the Ecclesall Bierlow Union poor-house with fresh air which answers the purpose admirably. An opening is made in the outer wall and a flue carried from thence between the floor timbers to the middle of the ceiling, where the air passes into the room; in order to prevent the current of air from rushing downwards, the aperture in the ceiling is masked by a large circular iron plate, on to which the air impinges, and is thrown off in all directions horizontally, gradually mixes with the air in the room, and drives out the foul air. This plate is fixed to a screw passing through its centre; and by turning the plate round, the aperture may be closed or opened little or much, and the supply of air regulated at pleasure. See drawing and section. There is another but less certain method of ventilating bed-rooms, uncertain on two accounts; first, because the living-room fire would not always be burning; and secondly it would be affected by changes in the atmosphere. The plan is as follows: to form small air-flues from the chamber and attics and carry them up by the side of the living-room fire-flue—the air-flues to commence close to the bed-room ceilings and continue up above the roof. The rarefication of the air in these flues caused by the heat of the fire-place, if constantly kept up, would ventilate the bed-rooms; but if a sufficient heat was not maintained, the ventilating process would cease, and cold air would come down the flues into the rooms, and the consequence would be that the apertures would be stopped up and the partial efficiency of the ventilating flue destroyed.



A. Culvert for gas and water-pipes.
B. Common sewer. C. Trap.

I think it most desirable, both on account of their more exclusive usefulness and greater economy to the town, that water and gas-works should, if possible, be the property of the town, and be managed for the benefit of the inhabitants generally, all profit derived therefrom to be used for public purposes.

The Board of Surveyors of the Highways appear to be the proper parties to undertake the management of these works, the attention of the surveyors and their officers being principally directed to engineering pursuits; and besides, as the streets are being continually broken up for laying either gas or water-pipes, and much unnecessary expense incurred thereby, it seems to me that the interest of towns would be bes secured by uniting the water and gas-works with the highway management.

If a regular system of drainage be introduced, connecting water-closets and soil-vaults, and for carrying away the mud, &c., from the streets, how valuable for such a purpose would be the well-directed use of any surplus water, and during the rainy part of the year when water was abundant all the sewers in the town might be scoured out at little or no cost. If the authorities of the town had the control of water and gas, there would be no need to deal both out with such a niggard hand, because, after supplying the inhabitants at fair prices for their own private comsumption, the surplus might be used without scruple for the use of those who pay for it, and who will gain nothing by stocking up or wasting gas or water rather than lower the price.

It would be highly advantageous, both for the public health and economy, if there was some well-considered legislative enactment to enable and perhaps to make it imperative on surveyors of highways to carry out by degrees a general plan of drainage, in both towns and villages. In the town where I reside, till within the last 20 or 30 years, sewerage has been left to the owners of property, who were compelled to drain their cellars, otherwise none would have been made.

It is not in my power to state how much extra cost the owners of property have incurred by every one doing his own work than would have been the case had the whole been done by the town, supposing they had to pay the town for doing the work for them; but I think, from what I have seen, I shall be within compass if I say the cost has been at least threefold.

If I might be permitted to recommend a plan which would in my opinion have a tendency not only to improve the sewerage but economise the expenditure, I would have a common sewer on each side of all the wide streets, if possible just under the channels or curb stones, the bottom of the sewers to be 12 or 14 feet below the roadway, and at least 4½ feet high. Into these drains I should of course turn all the house-drains, being properly trapped above the common sewers. I would have another vaulted passage for the express purpose of fixing therein water and gas mains, so that mains might be laid or repaired, and the inhabitants supplied with water and gas, without obstructing or damaging the carriage-way at any time.

The real meaning of the word economy in the expenditure of public money, as applied to the sanatory condition of towns, especially the wholesome ventilation of house drainage, and the general comfort and convenience of the inhabitants, is little understood. If the wealth of a nation be its population, is there nothing saved to the public by preventing (as far as the adoption of such measures can, and there are many proofs that much, very much, can be done) malignant and other dangerous fevers caused by an accumulation of stagnant water and filth.

The preservation of the public health is not merely an act of humanity, but a substantial saving of public money. The loss of health impoverishes families sometimes to such an extent as to compel an application to the parish for relief; and when the heads of families are taken away, how are the (too frequently) helpless wives and children to be provided for, but out of the public purse? Look at the subject in any way, and it will be found that the cost consequent on the loss of health and premature death of the working classes falls on the public, either directly by parish relief to the survivors, or indirectly to the contributions of private individuals. If this be so, what is it but an improvident waste of life and money to delay the introduction of those sanatory regulations which will no doubt be so beneficial to the public health?

Nothing would add more to the convenience of the male population of large towns than the introduction of urinals in the streets. I need not dilate on the great injury sustained by many persons in consequence of their inability to find a convenience "where decency does not forbid;" neither need I point out the outrage on female delicacy by the too frequent and in many cases of absolute necessity, of an exposure equally painful to both sexes: it is always best to provide what is necessary fairly and without disguise, making it as decent as possible. Matters of detail requiring constant attention should be superintended by the police, such as inspecting water-closets, or privies of the working classes, common yards, pumps, traps, urinals, &c., with power, if need be, to order them to be cleansed, and, on conviction before a magistrate, fine parties for neglect.

It is worse than useless to legislate upon matters of this description unless Parliament provide means for carrying their Act into effect; no Act of Parliament having for its object the improvement of the health of towns can be carried into operation unless parties are employed to be constantly on the look-out to prevent the provisions of such Act becoming a nullity.

There is a considerable waste of money in almost every branch of the public service, from the apathetic indifference of many persons annually elected to render their gratuitous services as overseers of the poor, guardians, surveyors of highways, &c. It is notorious that the duties of such persons are lamentably neglected and left almost entirely to clerks; truly has it been said "everybody's business is nobody's business," everybody meaning the public, and perhaps nobody the overseers. When anything very flagrant happens—and it must be very flagrant indeed to rouse the public attention—objections are raised against the appointment of individuals to public offices, when it is known that they have attained their situations by some manœuvre to serve their own interests or the interests of some of the paid officers. One thing is clear enough, (excepting in extraordinary occasions,) the clerks select and appoint who they think proper—in fact they choose their own masters either directly or indirectly. Such a state of things ought not to be permitted; for if the selection be as good as could be wished, the officers have an immense advantage, by being in possession of the minutiæ and ins and outs of the business, while the overseers, &c. are probably as ignorant as children who have got their first lesson to learn. Since Boards have been more generally introduced, it would appear as though individual information on details had gradually diminished. Each member of the Board probably quiets his conscience by hoping his colleagues, some of whom have more leisure than himself, will pay close attention to business, or at all events the clerks and auditor, if there be one, will take care that all is right; so that while on the one hand Boards have undoubtedly prevented that barefaced jobbing so prevalent under the old system, on the other hand it is to be feared the members generally act as though their duties extended no further than sitting in council at the Board.

For the salutary regulation of public affairs, Central Boards are indispensable to prevent, as far as possible, the appointment of improper persons to public officers, whether honorary or paid, and mismanagement, jobbery, and peculation. Every town should be divided into districts, and one or more members of the Parochial Board selected therefrom. If the Board immediately after its appointment was divided into a given number of committees, each having its exclusive department particularly defined, and required to present a report of the business in hand periodically to the Board, this division of labour, with the necessity of doing it, would make the task both easy and effective.

The auditors appointed under the New Poor Law are all very well in their way, but they can only detect mischief when it is completed. What is wanted is some method of preventing, or at all events nipping, it in the bud. Auditors see only the surface after everything has been smoothed off ready for them, whereas they ought to see the working of the machinery from the beginning to the end, as well as the result.

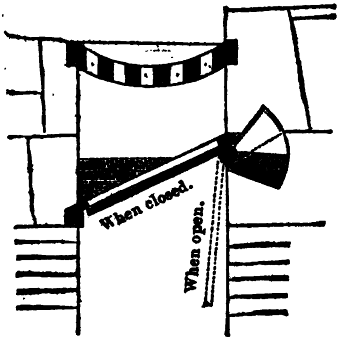
Might not one or two respectable and responsible persons, who should occupy their time entirely with public business, be appointed by all the local Boards, with salaries subject to the approbation of the Board of Control, to take upon themselves the general surveillance of all parochial affairs, and audit all accounts, not interfering in the slightest degree with the acts of the different Boards, but to see that their orders are properly carried into effect; to have unlimited power to inspect all books and documents at any time; in short, to see that the officers honestly and diligently discharge their duties themselves, being required to render periodical reports on the sanatory condition and general state of the town, the account and conduct of the officers, &c., to the Central Board.

The Central Board should be composed of gentlemen who have had experience in such business as will come before them. No engineers or professional men should be on the Board, although it would be advantageous to have a consulting engineer. The Central Board should have control over highways, sewerage, water, gas, and the general health and sanatory condition of towns. The business of the Board would not be merely to control, but to collect and store up valuable information on all matters connected with their office, and distribute such information, after its merits have been tested, for the use and advantage of the whole kingdom.

The Commissioners should abstain from making any local appointment, leaving such appointments to the local Boards, merely reserving to themselves the right of inquiry into the competency of the parties appointed, and if proved incompetent, to direct the election of a more suitable person. There should be some test of the qualifications of paid local surveyors before their appointments are confirmed; but great care should be taken that the test is as simple as possible, so as not to prevent persons who have not been regularly educated for the office from being elected, because it frequently happens that such persons being practically self-taught are more efficient than theoretical book students. I should like to hear of a plan for rewarding meritorious public servants; we have plenty of laws for punishing persons who do ill, but not one that I know of for rewarding and encouraging those who do well.

Much benefit and great saving would accrue to towns if the Central Board were to order a general plan to be laid down of each town, showing the common sewers already made, and the best plan of carrying out, from time to time, a complete system of drainage. When such plans have been approved by the local and Central Boards, no alterations should be allowed, unless satisfactory reasons can be assigned, and the approval of the Commissioners obtained.

The plan I propose for trapping the sewers, grates, &c., consists of an iron frame fixed in a sloping position, an iron or wooden door to be hung thereto, having a weight beyond the hinge or centre sufficiently heavy to keep the door close with the weight of a small quantity of mud or water upon it; when an additional quantity was thrown in, the trap-door would sink and let the water and mud into the common sewer—see Plan. The advantage of this plan is its simplicity, and self-acting, and self-cleaning principle. When there was no surface-water passing into the sewer, the trap would of course always be closed.



Trap for Street Grates.

(Signed) William Flockton, Architect.

Sheffield, April 17th, 1844.

REPORT

ON

THE STATE OF THE CITY OF EXETER.

By THOMAS SHAPTER, M.D.

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REPORT *on the* SANATORY CONDITION *of* EXETER.

By Thomas Shapter, M.D.

Exeter, the capital of the south-western peninsula of England, situated 50° 45′ north latitude, and 3° 41′ west longitude, is a densely inhabited and compact city, occupying the flat summit and declivities of a ridge-like hill, which rises gradually from the eastern bank of the river Exe to the average height of about 150 feet above the high-water level. This hill presents gentle declivities on its eastern and south-eastern sides, and abrupt steeps on its north and north-western sides. This natural disposition of the ground presents every facility for the most efficient drainage, and renders any obstruction to the free flow of flood water next to impossible. The neighbourhood of Exeter abounds with very beautiful country, which is peculiar from its extreme variety; within only a short distance, presenting the different aspects of moor, mountain, meadow, and woodland scenery. Its general character is that of a succession of small undulating hills, diversified by bolder swells, which, increasing in height as they recede from the city, are eventually lost in the elevated ranges that form its protecting boundaries; so that Exeter, though for the most part standing on high ground, is yet surrounded on every side by a noble, though somewhat distant, amphitheatre of hills, excepting to the south-east, where the broadly-expanded estuary of the Exe opens to the English Channel. The more prominent boundaries of the neighbourhood, by land, are, to the south-west, Haldon, and, at some distance beyond, the long line of Dartmoor; the former presenting a protecting barrier of more than 800 feet above the level of the sea, while the latter is an extensive mountain ridge, whose mean height is 1792 feet, its highest point, Cawsand Bog, being, according to the survey of General Mudge, upwards of 2090 feet. To the north are the Whitstone Hills, which, from their proximity, and height of 740 feet, form a screen of the most essential benefit: these, with an interval of less elevated ground, are irregularly connected by the Stoke range to the Woodbury Hills, which present themselves as the high lands to the eastward.

It is so well understood that the nature of the soil modifies the climate, impresses a character on the waters, and influences in many respects the occupation of the inhabitants and the general condition of the animal economy, that I feel it would be an omission to pass over all mention of the geological formation of this district. The rocks which here offer themselves to notice include some of a very extensive series, ranging from the granite to the lower cretaceous group, viz., granite, grauwacke slates, carbonaceous rocks, schists, limestone, new red sandstone (including *Exeter conglomerate*), green sand, granitic green stone, and trap rocks. For any very detailed or particular description of these rocks, the comprehensive Report on the Geology of Cornwall, Devon, and West Somerset, by Sir H. De la Beche, may be consulted. I shall only briefly observe upon the economical purposes of those upon which Exeter itself stands, viz., the schist, the new red sandstone, and the trap. The *schist*, provincially called schillet, varies much in hardness and durability, being in some places friable, in others exceedingly hard, and having occasionally a conchoidal fracture. In this latter form it is a stone very well adapted and frequently applied to the purposes of building and road-making. In some places it passes into roofing slate, and as such is occasionally used; it is, however, of a very inferior quality. The minerals of importance occurring in the schist are manganese, lead, and, in small quantities, copper. The only mines now in full work in the immediate neighbourhood of Exeter are those of manganese. The soil, produced by the decomposition of the superficial parts of this formation, is well adapted to the growth of wheat, and the oak grows in it as a weed. It is, however, a cold soil, and the seasons are considered nearly a fortnight later than on the red land. The *new red sandstone*, on which Exeter is chiefly built, varies from a compact stone to a fine loose-grained sand, with here and there embedded clays and masses of a peculiar conglomerate. The clays are used largely for brick-making; in fact, it is the occupation entailed upon the inhabitants of the city workhouse. The conglomerate is a good building-stone, and much used; the compact sandstone is used for flooring. The soil of the sandstone district is generally dry and fertile, and when the sands have a sufficiency of more compact materials mixed with them, their productive quality is good. In some parts the marls are firm and retentive, and consequently suffer much from excess or deficiency of rain. The *trap rocks* are chiefly interesting as building-stones, and, in Exeter and the immediate neighbourhood, are extensively quarried for this purpose. Under water they are excellent, resisting its action almost equally with any known stone; when exposed to the variations of the atmosphere, that portion which is veined with calcareous spar decays soonest, the spar, losing its water of crystallization, disappears, and the masses of rock contained between the veins crumbles into dust; when the veins are of quartz, its durability is much greater. They resist a long time the action of the atmosphere, and firmly bind together the masses of claystone which they enclose; but the most durable part of the rock is that which at first sight one would not be inclined to select, viz., the vesicular portion whose vesicles are generally empty; it bears the tool, and can be wrought. In examining the older buildings of the district where this rock has been employed, it will be found that the faces and edges of stones taken from the vesicular part are sharp and perfect, whilst the veined stones are somewhat decayed.

The river Exe, from which the city takes its name, is the great and important water of the south of Devon. It has its origin in the extensive moor district, called Exmoor, from whence it flows through varied and beautiful country, and expands itself into a fine river at Tiverton; then winding through the romantic and wooded vale of Bickleigh, it flows over the new red sandstone, between the red rock of Thorverton and Silverton, and between Brampford Speke and Nether Exe, and pursues its course over the schist to Exeter. Below the city, at the uay, it again flows upon a bed of new red sandstone, falls over many eirs, and, passing through fertile meadows, reaches Topsham; flowing between Lympstone and Powderham, and over the bar at Exmouth, which is of red sandstone rock, and not of sea-sand, as is generally supposed, it empties itself into the English Channel, having, from its rise to its mouth, pursued rather a direct course of 60 miles, with a fall of 1 foot in 408. The Exe receives several tributary rivers; the Creedy, the Culm, the Kenn, and the Clyst, are in the immediate neighbourhood. The height of the river is affected by the tide to within a mile of Exeter, where any further influence is prevented by a weir. At the quay, immediately below the walls of the city, the breadth of the river is 120 feet, and its depth averages rather more than nine. Though the city itself is above the influence of floods, yet the river is often, by the melting of snow, and continued heavy rains, considerably swollen, when its waters come down greatly discoloured, especially after the junction of the Creedy, which passing through the red sandstone district between Sandford and Upton Helions, discharges itself, loaded with this soil, into the Exe, two miles above the city. These floods usually take place between November and March, but more particularly in November; they seldom rise more than seven feet above the summer level of the river, though at rare intervals, floods of a much more important character occur. The Exe water, on these occasions, is rendered turbid by the suspension of the different soils washed from the up countries, otherwise its general character is that of being clear, soft, and pure. By analysis it is proved to contain muriate of lime and a trace of iron; its taste, from a deficiency of fixed air, is somewhat flat, and consequently it is not pleasant as a drink, but for all domestic purposes it is perfectly unobjectionable.

Within the district of the city the soil is plentifully perforated by springs; and at comparatively short distances from the surface, varying from 15 to 30 feet, a good supply of water may be met with. The chemical composition of these waters is somewhat modified by the geological character of the soil from whence they proceed. The water of the *new red sandstone* is clear, transparent, and inodorous, sp. gr. 1002, temperature 53°, contains free carbonic acid, muriate of lime, sulphate of lime, carbonate of lime, and sulphate of alumina. The water of the *trap* is sparkling, clear, transparent, inodorous, and slightly styptic to the taste, sp. gr. 1003, temperature 52°, contains free carbonic acid, muriate of iron, muriate of lime, sulphate of lime, sulphate of alumina, and carbonate of lime. The water of the *schist* has a sp. gr. of 1003, temperature 52° 5′, contains free carbonic acid, muriate of iron, sulphate of iron, carbonate of iron, and sulphate of lime. On taking a review of these waters, it will be seen that those which proceed from the trap and new red sandstone do not essentially differ, the character in the impregnations of each being muriate and sulphate of lime, with a small portion of sulphate of alumina. The waters of the *trap* contain a little muriate of iron, which is not to be found in those of the new red sandstone; this is easily accounted for by the latter being a deposit from the debris of older rocks, which have been broken down and washed by diluvial waters, so that the iron has been precipitated as an insoluble oxide, imparting to the strata its ferruginous tint.

The waters from the purer springs of these formations are clear, light, palatable, wholesome, and generally available for domestic purposes; but when the mineral impregnations are in excess, as is often the case, they are hard, cause roughness of the skin, and lie heavy on the stomach, often occasioning slight symptoms of a dyspeptic character; these defects are sometimes obviated by boiling, which precipitates a large proportion of their solid contents. These waters, as is generally the case with such as contain lime, are well adapted for brewing and distillation; the fermentation of worts is better effected by them than by the softer waters, which prejudice, often at a great expense, seeks for in preference. The general character of the waters of the schist formation is that of being clear, sparkling, inodorous, styptic to the taste, and usually depositing, after a few days' exposure to the air, a quantity of ferruginous matter. These, though inapplicable to many domestic purposes, are generally wholesome; some of them from containing an excess of free carbonic acid, and a very large proportion of iron, are entitled to be called mineral waters of the class of the acidulous chalybeate, and, when drunk fresh, are eminently serviceable in many cases of general debility and indigestion. The temperature of the above springs is slightly in excess of that of the mean of the climate; this appears to be commonly the case throughout the temperate zone, whenever the springs proceed from a moderate depth below the surface, and which, therefore, may be concluded to be the case with those of this district.

The chief characteristics of the climate of Exeter are those of being warm, soft, mild, equable, calm, and free from storms; and though subject to a large share of rain, it seldom occurs that a whole day is so unceasingly wet as not to afford some hours, either early or late, sufficiently fine for out-door exercise. During the winter season the temperature rarely maintains for any length of time a degree so low as to render the climate particularly inclement, frost seldom occurring or continuing many days; and though the air is not unfrequently damp, yet, from the then usual prevalence of warm westerly wind, the moisture which it contains is not cold and chilling. The character of the spring does not materially differ from the winter, excepting in the air being less damp and the days less rainy; and towards its close, north-easterly winds somewhat prevail. The summer is of moderate warmth, dry, with occasional showers; the winds blowing, for the most part, from the north-west, are cooling and refreshing, but the evenings and nights are sometimes cold and damp. The autumn is warm, rather damp, and rainy, and peculiarly the season of the "Devonshire Drizzle," a rain so light as to deposit itself like a thick dew; the winds during this season are chiefly from the west. By way of marking the general mildness of the climate, it may be mentioned that many of the tender and delicate exotics of more southern climes flourish in the open air, and are not destroyed by exposure during the winter season.

Such is a rapid and very general sketch of the physical condition of the district of Exeter as it is, uninfluenced by the hand of man. Its climate genial, good water abundant and accessible, surrounded by fertile country, sheltered in its position, the hilly character of its surface yielding facilities for drainage and ventilation, thus exhibiting unusual capabilities for supplying the necessities consequent on the congregating together of large masses.

We shall now consider Exeter as a city, and as the habitation of man. Like all other towns in this ever-changing kingdom, history presents it under many different conditions. From a principal town of the ancients, it became a great and very important Roman station, and subsequently one of the most influential cities of the baronial period of England, not only from being strongly encompassed by walls, the greater part of which are now standing, but from the wealth and character of its inhabitants, being very early one of the great centres of the manufacturing industry of the kingdom, which character it maintained until a recent period. It now, however, contains a population marked by no very distinctive character. Upon the early, or what may be termed antiquarian history of this city, I have now no intention to enter, but propose, by passing in review the very altered states it presents during more recent years, to estimate the influence, upon human life and happiness, of some of the ordinary circumstances consequent upon the collecting dense masses of people together in towns.

In looking, then, at the more recent history of Exeter, we find it presented to our notice under three very different aspects, which may be thus particularized:—

1. A.D. 1800.—Exeter a manufacturing city, ill supplied with water, its drainage badly effected, and only by surface gutters: population moderately dense.

2. A.D. 1831.—Exeter no longer a manufacturing city, generally much improved, yet imperfectly drained, and ill supplied with water: population increased, and rather more dense.

3. A.D. 1841.—Exeter considerably improved, well supplied with water, a good and extensive system of under-sewerage: population, though considerably increased, not more dense.

After comparing these three epochs of this city's history, its improved condition in 1841 may be contrasted with that of other large towns in the kingdom, the natural position and local regulations of which do not provide equal advantages for their population.

A.D. 1800.—EXETER A MANUFACTURING CITY, ILL SUPPLIED WITH WATER, ITS DRAINAGE BADLY EFFECTED, AND ONLY BY SURFACE GUTTERS: POPULATION MODERATELY DENSE.

At this period, Exeter possessed much of the character which had belonged to it from very early times, for though it is said that, "in 1768, the spirit of improvement began to manifest itself; and in the following year, that the great increase of wheel-carriages made it necessary to improve the avenues of the city," nevertheless, in 1800, it retained for the most part its original character. It was a compact city, picturesquely situated in a grove of trees, its open fields occupied by "racks" for stretching and drying the newly-washed, cleaned, and dyed serges. The city itself, almost confined within its original walled boundaries, was divided tolerably equally into four parts, by four principal ways meeting in the centre. With the exception of the great street running from east to west, the streets were generally narrow, and the city abounded in courts, lanes, and alleys; it was almost entirely paved with round stones, which pavement was locally known by the name of "pitching;" this usually ran in declivities from the sides towards the centre, so that in the middle of the road was usually seen the gutter, which conveyed away all the nuisance of the city. With the exception of a private drain in a very limited portion of one of the streets, (the North-street,) there was no other means of carrying off the filth than was afforded by these surface gutters. Of the consequences of this state of things, some appreciation may be formed, when it is recorded in 1801, "that a great nuisance, which had long been complained of, viz., the filthiness of the streets of this city, was this year removed by the Chamber, who, by an act of common council, made a law, which forbade, under severe penalties, any person from throwing or laying ashes, human ordure, or any kind of filth or dung into the streets or kennels, and compelling every householder to sweep the pavement before their houses three times in every week, and by this means, the streets (which before for their filthiness were become proverbial) are kept clean and sweet, to the great comfort and health of the citizens, and a great reproach is removed from the city; the waste water from the conduit was by means of pipes conveyed into the Butcher-row, where its current is of great utility in cleansing the kennels from the blood and filth which before lodged in them, and was very noisome to passengers." But the state of the city is yet more strongly marked by the information given me by an old inhabitant, who assures me, that so late as 1808, there was but one water-closet in the city, and that emptied itself into the open street; that it was then the practice for the inhabitants to have tub receptacles within their own houses for the reception of the necessary filth, and which, as occasion required, were, towards evening, carried through the streets in order to be emptied into the river. The feelings of the people revolting against this state of things, induced the Chamber, in 1809, to procure powers from Parliament to enable them to sewer the city; this work they accordingly commenced, but it was subsequently carried on by the Commissioners of Improvement, a body specifically appointed for this and similar purposes under an Act of Parliament in 1810. Bad as it may be supposed the state of Exeter must have been at this early period, it will be yet more fully appreciated, when it is understood that the city depended almost entirely for its supply of water on the ordinary sources of rain, springs, and sunken wells, on the conduit and the river. The water from the latter was chiefly afforded at this period by water-carriers. There was, however, a limited and uncertain supply from the then water-works; of these, as well as the conduit, it may be as well to say a few words.

The Conduit.—The water supplied from this ancient fountain was deemed of very great importance; accordingly many references, connected with it are found in the different annals of Exeter. As early as 1221 this water was brought into the city from its present sources in the upper part of the parish of St. Sidwell at a level of about 30 feet above the spot, at "Quatrefois," where it was delivered. In 1346 it is mentioned as conveyed into St. Peter's Yard. In 1411, the supply being insufficient, an addition was provided by the bequest of a citizen. In 1419 and 1438, mention is made of the pipes being repaired, &c. In 1461, the conduit itself was rebuilt; in 1700, it was taken down again, in consequence of its position being found inconvenient, and removed to one side of the principal street, a little above its former position; here, however, from the numbers resorting to it, the inconvenience was found to be so great that, in 1795, it was again removed and fixed in South-street, where it still remained in 1800. The water delivered at this fountain issues from the new red sandstone, and possesses to an eminent degree all the better qualities of the springs flowing from this formation, and which have been described in a previous page. It is clear, transparent, tasteless, and inodorous, sp. gr. 1002, temp. 53°, contains free carbonic acid, muriate of lime, sulphate of lime, carbonate of lime, and sulphate of alumina. It proceeds from two springs at a short distance only from each other, and which yield, in three minutes and fifty-two seconds, an imperial hogshead of water. There also formerly stood, at a much lower part of South-street, another conduit, called the "Little Conduit," but whence the source of the water which supplied it was derived I have not been able to ascertain. In 1553, there is a notice of its having been rebuilt, but subsequently, from the pipes being out of order, a well was sunk over the spot, and a pump erected instead; this pump stood there at the period which is now being described.

The *Water-works* were established by the Chamber, under Act of Parliament, in 1694, and by them were let out in lease for a period of 200 years. In 1800, they were worked by a large stream-wheel, in a leat immediately above and contiguous to the city. The supply from this source was, however, uncertain, insufficient, and not very pure; and the works were quite incapable of distributing it to the higher parts of the city; in fact, water was with difficulty raised as high as the reservoir at the back of the Guildhall. The pipes, which were of wood and liable to constant leakage, were but scantily laid, and such was the inadequacy of the works, that the usual deficient supply was occasionally entirely interfered with, on the occurrence of floods, for five or six days, and during droughts, for periods of even three months; these stoppages were far from infrequent. It would appear, indeed, that a large and wholesome supply of water is a luxury which has only been properly appreciated within the last few years, for the late proprietor of these water-works assures me, that shortly after he became the lessee in 1808, but one individual in Bedford Circus, (then a new and most fashionable row of houses,) would consent to take it in; and that subsequently, in 1815, on the pipes being extended to the hospital, for which the sum of 152*l.* was paid besides 10*l.* for the annual supply of water, it was provided in the agreement, that as individuals, residing in the course traversed by the main on its way from the reservoir, would probably avail themselves of the supply thus afforded, the proprietor of the works, for every family above the number of ten so taking it in, should refund to the hospital the sum of 7*l.*; at the expiration of the agreement in 1833, though the pipes passed though the most wealthy district of the city, this number had not been exceeded.

The population of Exeter in 1800 amounted to 16,827, of which number 7142 were males, and 9685 females, each house being inhabited, on the average, by 1·47 families, and 6·49 persons. In the following table (I.) the population is set out in detail according to the different parishes of the city, together with the gross amount of the mortality and its annual average.

TABLE I.—The POPULATION of EXETER, in 1800; together with the Gross Amount of MORTALITY for Ten Years, and the Mean Annual Mortality per Cent.

1800.	Houses.			Persons.			Actual Mortality from 1796—1805.			Annual average Mortality per Cent.		
	Inhabited.	By how many Families	Uninhabited.	Males.	Fem.	Total.	Males.	Fem.	Total.	Males.	Fem.	Total.
WELL-TO-DO DISTRICT.												
St. Martin	45	51	5	149	161	310	23	16	39	1·54	0·99	1·25
Bedford Precinct	17	17	.	45	71	116	.	.	.	.	.	.
St. Petrock	44	54	2	132	155	287	12	15	27	0·90	0·96	0·94
St. Stephen	61	74	2	184	297	481	37	39	76	2·01	1·31	1·58
All Hallows, Goldsmith-st	50	59	1	126	209	335	16	14	30	1·26	0·66	0·89
St. Laurence	74	123	4	228	320	548	49	56	105	2·14	1·75	1·91
Total	291	378	14	864	1,213	2,077	137	140	277	1·58	1·15	1·33
POOR DISTRICT.												
St. Edmund	206	283	.	405	513	918	75	82	157	1·82	1·59	1·71
St. Mary Major	299	552	.	938	1,197	2,135	257	291	548	2·73	2·43	2·56
St. Mary Steps	101	138	8	298	421	719	83	96	179	2·78	2·28	2·48
Total	606	973	8	1,641	2,131	3,772	415	469	884	2·52	2·19	2·34
MIXED DISTRICT.												
The Close	7	7	1	6	26	32	62	72	134	.	.	.
St. David	313	443	19	804	1,050	1,854	196	211	407	2·43	2·00	2·19
St. John	72	107	5	230	391	621	52	52	104	2·26	1·32	1·67
St. Kerian	38	58	4	104	126	230	30	22	52	2·88	1·74	2·26
St. Mary Arches	59	93	5	160	218	378	38	41	79	2·37	1·88	2·08
St. Pancras	35	53	.	93	138	231	24	24	48	2·58	1·73	2·07
St. Paul	189	269	10	492	606	1,098	118	121	239	2·39	1·99	2·17
St. Olave	91	118	6	262	314	576	44	66	110	1·67	2·10	1·90
St. George	75	143	7	291	351	642	70	66	136	2·40	1·88	2·11
Trinity	279	345	15	821	1,119	1,940	205	204	409	2·49	1·82	2·10
All Hallows-on-the-Walls	85	157	4	302	367	669	62	67	129	2·05	1·82	1·92
Total	1,243	1,793	76	3,565	4,706	8,271	901	946	1,847	2·52	2·01	2·23
St. Sidwell	450	689	23	1,072	1,635	2,707	611	759	1,370	5·69	4·64	5·06
Exeter	2,590	3,833	138	7,142	9,685	16,827	2,064	2,314	4,378	2·88	2·38	2·58

At this period Exeter was essentially a manufacturing city, and as such was of considerable importance. It was the great emporium for the thinner kind of woollen goods, such as serges, druggets, estamines, and long ells, which, being spun and woven in the towns and villages around, were dyed and finished within the city, whence they were shipped to Spain, Portugal, Holland, Italy, and the East Indies. It was estimated, in 1800, that eight out of ten of the whole population were directly or indirectly engaged in the various departments of its manufacture, and from information derived from the older inhabitants I should not be inclined to view this statement as exaggerated. The early establishment and importance of its manufacturing interest may be somewhat appreciated from the numerous endowments and gifts still remaining for the aged poor connected with its trade, as well as from the frequent notices of it occurring in the annals of the city. So early as 1538 we find it said that, the woollen manufactory greatly increasing in this city, the mayor erected a market for the sale of wool, yarn, and kerseys, to the great advantage of the citizens; and in 1618, that the woollen trade was greatly advanced, and proved a source of wealth hitherto unknown to the citizens, their trade before this period being confined mostly to the opposite coasts of France and Germany, but now it was extended to Italy, Turkey, and other parts of the Levant; and they sent their cloths in large ships of their own, and brought back the commodities of those countries; thus many families rose to opulence, and laid the foundation of great estates, which are now enjoyed by their descendants. In 1702 it is again said that trade improves, and that fresh markets are opened for the consumption of the home produce; and the extent of foreign connexion may be appreciated from the fact, that on the occurrence of the great earthquake at Lisbon on the 1st of November, 1755, the news of it is said to have much alarmed the merchants of Exeter, who had great connexions and property there; but their loss (which was very considerable) did not prevent them from expressing their philanthropy, and entering into subscriptions for the relief of the distressed inhabitants: accordingly two ships were sent from this port laden with provisions, household furniture, and other necessaries, which arrived safe, to the great comfort of the afflicted Portuguese.

The operative part of the woollen trade carried on within this city was entirely confined to the finishing the pieces for use after they had been spun and wove. From the warehouses within the city the raw materials were distributed into the neighbouring villages, and then returned in the piece. Here it was submitted to a variety of processes, as the washing, milling, fulling, dying, raising, cutting, hot-pressing, and packing. Some of these employments are carried on with the inconvenience of great exposure to wet; with this exception, there was nothing ostensibly injurious to health.

The houses at this time were of wood, stone, and brick, with slated and thatched roofs; they were huddled together in masses, low pitched, small, and inconvenient, with here and there a more recently-built house of greater dimensions. It was then the custom for the merchant to live in the midst of his business, so that the affluent and poor were much mixed together.

Such then was the condition of Exeter in 1800, inhabited by a manufacturing and tolerably dense population, the streets for the most part narrow, no efficient sewerage; the water, though wholesome in itself, extremely scanty in its supply, and with no provision (save that dependent on the advantageous situation naturally belonging to it) for obviating the unwholesome consequences necessary to the congregating of large masses of people in narrow limits. The effects of such a state of things on the lives of its inhabitants the above table somewhat exemplifies. The annual average mortality amounting to 2·58 per cent. (2·88 males and 2·38 females) upon the population, a rate very much above the present average, and indicative of an amount of death which would now be esteemed excessive.

A.D. 1831.—EXETER NO LONGER A MANUFACTURING CITY, GENERALLY MUCH IMPROVED, YET IMPERFECTLY DRAINED, AND ILL SUPPLIED WITH WATER: POPULATION INCREASED, AND RATHER MORE DENSE.

We shall now turn to a consideration of the condition of Exeter in 1831. It will be found that the intervening 30 years, between 1800 and this period, had wrought in its appearance and population some very remarkable changes. No longer girt about by its ancient boundaries, houses for its now increased and increasing population had been planted in its suburbs, where shortly before avenues of trees had flourished, and it was no longer a city in a grove. The ancient character of its streets had disappeared, many of the narrow ways had been thrown down, a better system of drainage had been established, and the spirit of improvement so characteristic of the age, had done much towards ameliorating the too obvious disagreeables of its former condition. Moreover, the occupations of its inhabitants had materially changed, for its prosperous and all engrossing woollen trade had almost entirely declined, the workshops connected with it had become devoted to other purposes, and the neighbouring fields, previously lined with "racks," were given up exclusively to pasturage. Of some of these alterations we shall now speak more particularly.

Through the instrumentality of the Commissioners of Improvement, an extensive system of sewerage had been introduced; and, though the town could not yet be said to be properly or satisfactorily drained, the most manifest improvement had taken place. In all the principal streets the surface gutters had disappeared: and the adoption of sinks and water-closets was becoming general. Nevertheless in the poorer parts of the city much that was objectionable still remained, little improvement, save judicious and very useful police regulation, having as yet interfered with their former condition. Of some instances of remaining nuisances in certain localities I shall presently speak more particularly. The sewers and drains which were put in at this period do not appear to have been formed upon any general plan, their shape being found very various, though the generality of them may be described as square and V-shaped. The introduction of this somewhat imperfect sewerage was undoubtedly a great improvement upon the old system of things, and tended very much to the personal comfort of the inhabitants. Unfortunately, however, such full benefits as might have been expected from it were not realized from the still existing very insufficient supply of water; for though some improvement had taken place in this respect also, yet the supply was by no means adequate to the requirements of so large a city. In 1808 the unexpired lease of about 80 years of the water-works, previously referred to as established by the Chamber under an Act of Parliament, was bought by James Golsworthy, Esq., of the then lessee, Mr. Rouse. Mr. Golsworthy found them insufficient, as has been previously described, with power scarcely sufficient to raise water to the city, and with wooden pipes, then in common use throughout England, leaking at all points. Mr. Golsworthy immediately applied his ingenious mind to their improvement, and this he effected by means of much assiduity and the outlay of capital. It is but due to this gentleman to state, that he was the first who seriously thought of the practicability of iron pipes for the conveyance of water, and that, in spite of persuasion to the contrary by the directors of some of the London companies, he pursued his purpose, and in 1811 proceeded to Chesterfield, where he had some cast, of about six feet in length, and fitting together by funnel-shaped joints. The success attending their adoption convinced those who had previously argued against their use, and in four years afterwards they were employed for the conveyance of water by the directors of the New River Company in London. Though, by the increased power of the engine, and by the saving from the leakage attending the use of wooden pipes, a much larger supply of water was insured, it was still quite inadequate to the uses of the city; in fact, if the increase of population be considered, almost as inadequate as it was in 1800; so that, Exeter depending on this insufficient supply, on the rain, the wells, the conduit, and the water-carriers, may at this period be still assumed to have been ill supplied with water.

Another great and very prominent change must, however, be remarked upon, viz., that of the occupations of the people. In 1800, eight out of ten were spoken of as engaged in the various departments of the woollen manufacture, connected with its finishing and exportation. In 1831 this trade may be said to have ceased, and the population, as regarded employment, to have had no very distinctive character. It may, at this period, be said to have consisted of a collection of gentry, tradespeople, artisans, and the ordinary admixture of poor. The population now amounted to 28,242, of which 12,683 were males and 15,559 females, being an increase since 1800 of 11,415. (See Table IV.)

Considering the altered condition of the population in respect to employment, it may not be uninteresting to see in what manner the intermediate increase in the population took place. The following table will show the amount of the population at each decadal census.

TABLE II.—STATE of the POPULATION at each decade, from 1800 to 1831.

—	1800	1811	1821	1831
Males . . .	7,142	7,908	10,335	12,683
Females . .	9,685	10,988	13,144	15,559
Total . .	16,827	18,896	23,479	28,242

From the above we observe that there was no very great increase in the population of the city from 1800 to 1811; but that from that time to 1821 and to 1831 the increase was very great, amounting in the 20 years to the very large number of 9346. Now this was precisely the period at which the woollen manufacture was leaving the town, and when, doubtless, all those engaged in it were foreboding, as was indeed most natural, the decline and ruin of the city, instead of which we find its population increasing, their personal comforts publicly considered and provided for, and the whole aspect of the city undergoing a change for the better. The increase in the population will be better appreciated from the following table, in which its advance is stated proportionally:—

TABLE III.—INCREASE per Cent. of the POPULATION of EXETER upon itself.

—	From 1800 to 1811	From 1811 to 1821	From 1821 to 1831	From 1800 to 1831
Males . . .	10·72	30·69	22·71	77·58
Females . .	13·45	19·62	18·36	60·65
Total . .	12·29	24·25	20·28	67·83

TABLE IV.—The POPULATION of EXETER, in 1831; together with the Gross Amount of MORTALITY for Ten Years, and the Mean Annual Mortality per Cent.

1831.	Houses.			Persons.			Actual Mortality from 1725—1834.			Annual average Mortality per Cent.		
	Inhabited.	By how many Families	Uninhabited	Males.	Fem.	Total.	Males.	Fem.	Total.	Males.	Fem.	Total.
WELL-TO-DO DISTRICT.												
St. Martin	45	57	3	113	185	298	7	11	18	0·61	0·59	0·60
Bedford Precinct	17	17	1	33	81	114	.	.	.	.	.	.
St. Petrock	40	50	5	106	161	267	12	10	22	1·48	0·62	0·86
St Stephen	61	73	2	193	289	482	22	22	44	1·14	0·76	0·91
All Hallows, Goldsmith-st.	50	82	3	187	233	420	33	40	73	1·76	1·71	1·73
St. Lawrence	85	117	4	291	329	620	67	48	115	2·30	1·45	1·85
Total	298	396	18	923	1,278	2,201	141	131	272	1·52	1·02	1·23
POOR DISTRICT.												
St. Edmund	206	336	8	713	810	1,523	194	165	359	2·72	2·03	2·35
St. Mary Major	388	821	23	1,665	1,851	3,516	452	464	916	2·71	2·50	2·60
St. Mary Steps	157	316	10	616	642	1,258	202	189	391	3·27	2·94	3·10
Total	751	1,473	41	2,994	3,303	6,297	848	818	1,666	2·83	2·47	2·64
MIXED DISTRICT.												
The Close	101	129	1	268	407	675	65	74	139	2·42	1·81	2·05
St. David	462	529	36	1,450	1,628	3,078	334	303	637	2·30	1·86	2·06
St. John	83	126	5	257	329	586	44	65	109	1·71	1·97	1·82
St. Kerian	71	110	4	221	249	470	44	31	75	1·19	1·24	1·59
St. Mary Arches	86	141	6	345	363	708	77	88	165	2·23	2·42	2·33
St. Pancras	50	85	1	173	206	379	38	37	75	2·19	1·79	1·97
St. Paul	244	355	13	749	889	1,638	172	175	347	2·29	1·96	2·11
St. Olave	142	246	28	446	518	964	96	98	194	2·15	1·89	2·01
St. George	116	240	6	447	461	908	133	119	252	2·97	2·58	2·77
Trinity	440	597	28	1,251	1,596	2,847	347	252	599	2·77	1·57	2·10
All Hallows-on the-Walls	142	200	13	401	488	889	99	95	194	2·46	1·94	2·18
Total	1,937	2,758	141	6,008	7,134	13,142	1,449	1,337	2,786	2·41	1·87	2·11
St. Sidwell	1,070	1,411	79	2,758	3,844	6,602	907	857	1,764	3·28	2·22	2·52
Exeter	4,056	6,038	279	12,683	15,559	28,242	3,345	3,143	6,488	2·63	2·02	2·39

By the statement in Table III. the population is seen to have increased nearly 68 per cent. from 1800 to 1831; but that by far the greater proportion of the increase took place between 1811 and 1831, the very period when the staple manufacture of the city was declining. If we look to the relative increase of the sexes during this period we observe this remarkable fact, that of the increase between 1800 and 1811 the larger proportion were females, while between 1811 and 1831, but more particularly between 1811 and 1821, by far the greater proportion were males; so that the decline of manufacturing interests was not only accompanied by a population progressing considerably in amount, but likewise in character as regards productive power. This latter circumstance was evidently due to an immigration of males from the surrounding country parishes, for the state of their population during this very time shows the existence of a disproportionate amount of female life.

We find then that the Exeter of 1831 is like the Exeter of 1800 in the deficiency of water, and in the unimproved state of some of the poorer districts of the town, but that it differs from it in having undergone various general improvements, in the introduction of a partial system of sewerage, in the absence of a manufacturing occupation, and in the increase of its population. We shall now turn to a consideration of the influence exerted, by such a change in the aspect of the city, on the rate of mortality of its inhabitants. In order to do this satisfactorily, we shall compare the mortality of this period with that of 1800, as furnished by the parish registers. The mortality of each period is deduced from a series of 10 years, the one from 1796 to 1805 inclusive, and the other from 1825 to 1834. In the following table the population and its accompanying mortality, at these two several periods, are contrasted together :—

TABLE V.—The POPULATION and ANNUAL MORTALITY per Cent. of EXETER in 1800 and 1831.

—	By how many Families each House is Inhabited.	By how many Persons each House is Inhabited.	Population.			Annual Average Mortality per Cent.		
			Males.	Females.	Total.	Males.	Fem.	Total.
1800	1·47	6·49	7,142	9,687	16,829	2·88	2·38	2·58
1831	1·48	6·96	12,683	15,539	28,242	2·63	2·02	2·39

From this it is immediately seen that the mortality in 1800 was very considerably more than in 1831; and it may even be assumed that it was proportionably greater than is here really expressed, for it must be borne in mind that the registration of burials at this earlier period was not kept with the accuracy of later times (since 1815 the forms and requirements in this respect have been more precise). Moreover the period from which the average mortality of 1831 (from 1825 to 1834) has been deduced includes the excessive mortality attendant on the occurrence of the epidemic cholera in 1832. Setting aside these reasons for supposing the mortality of 1800 to be understated, we see very broadly affirmed by the population and mortality registers of 1800 and 1831 that at this latter period Exeter, with a population increased nearly 68 per cent., with more families residing in each house, and with more individuals composing the members of each family, that its relative amount of mortality had very considerably decreased; in fact, that while the mortality of 1800 was, notwithstanding the necessary as well as supposed deficiencies of its registration, such as would be considered in the present day exceedingly high, being on the same scale as those of Merthyr Tydfil, Birmingham, Sunderland, Leeds, Rochdale, &c.; that of 1831, under only the necessary deficiencies of the church registration of burials, has a mortality ranging scarcely higher than that of Carlisle, Cambridge, Dudley, &c. Consequently the statement is justified that Exeter, ill-drained, ill-supplied with water, and its population engaged in certain departments of the woollen trade, was liable to a greater amount of mortality than Exeter generally improved, moderately well drained, and with a population, though more dense, unoccupied on any particular manufacture. We may, therefore, fairly conclude,—

I. That a population engaged in the finishing departments of the woollen trade, residing in localities, whatever may be their natural advantages, which are ill-drained and badly regulated, is liable to greater mortality than is merely proper to the congregating of masses together.

In looking accurately at this corollary, we observe that it has two conditions, viz., that of a population engaged in certain departments of a woollen manufacture, and that of an ill-drained and badly regulated town. Now it is by no means conclusive, from what has preceded, which of these two is the cause of the attendant undue mortality. It may be, on the one hand, that the occupation of the people is only a coincidence, and on the other, the insufficient drainage. It will, therefore, be worth while to examine to which of these causes the excessive mortality of this period is owing. In order to do this the more satisfactorily, I have divided the city into districts (reference to which may be seen in the preceding tables, I. & IV.). These districts have been determined chiefly by the present state and condition of their population, and somewhat by their rateable value. As frequent reference will, in the course of this paper, be made to these districts, I shall now more particularly describe them. Before doing so, however, I append a table, in which they are arranged in the order of their rateable value:—

TABLE VI.—RATEABLE VALUE of EXETER.

Population.	Rateable Value.			Average per Head.		
	£.	s.	d.	£.	s.	d.
31,333	133,448	0	0	4	5	2

WELL-TO-DO DISTRICT.

Parishes.	Population.	Rateable Value.			Average per Head.		
		£.	s.	d.	£.	s.	d.
St. Martin	254	4,332	0	0	17	1	1
Bedford Precinct	119	2,018	10	0	16	19	2
St. Petrock	267	3,061	10	0	11	9	3
St. Stephen	477	4,868	15	0	10	4	1
All Hallows, Goldsmith-street	360	3,436	5	0	9	10	10
St. Lawrence	641	5,539	10	0	8	12	10
Totals and Average . .	2,118	23,256	10	0	10	19	7

MIXED DISTRICT.

Parishes.	Population.	Rateable Value.			Average per Head.		
		£.	s.	d.	£.	s.	d.
The Close.	697	3,800	0	0	5	9	0
St. David	3,508	18,974	15	0	5	8	2
St. John	500	2,599	10	0	5	3	11
St. Kerian	402	2,037	10	0	5	1	4
St. Mary Arches	651	3,008	5	0	4	12	5
St. Pancras	363	1,674	5	0	4	12	2
St. Paul	1,398	6,284	15	0	4	9	10
St. Olave	912	3,918	10	0	4	5	11
St. George	685	2,622	0	0	3	16	6
Trinity	3,913	14,636	15	0	3	14	9
St. Sidwell	8,972	32,413	5	0	3	12	3
All Hallows-on-the-Walls . .	867	2,849	5	0	3	5	8
Totals and Average . .	22,868	94,818	15	0	4	2	11

POOR DISTRICT.

Parishes.	Population.	Rateable Value.	Average per Head.
		£. s. d.	£. s. d.
St. Edmund	1,595	3,922 5 0	2 9 2
St. Mary Major	3,496	8,455 15 0	2 8 4
St. Mary Steps	1,256	2,994 15 0	2 7 8
Totals and Average . .	6,347	15,372 15 0	2 8 5

It will be seen by the above table, that the rateable value of the property varies according to the amount of its population very considerably, from an average of 17*l.* 1*s.* 1*d.* to 2*l.* 7*s.* 8*d.* per head. The former sum indicates the enjoyment of affluent means, the latter the subjection to the privations of poverty; partly in accordance with these indications, and partly from personal knowledge of the localities and their inhabitants, the parishes of the city have been arranged into three chief districts, to which, for the sake of distinction, I have given the names of the "well-to-do," the "poor," and the "mixed." From this latter I have thought it right to separate one very large parish, viz., that of St. Sidwell (divided now into St. Sidwell and St. James, and containing more than one-fourth of the whole population of the city), because, from its very rapid increase, the mortality stands in a different relation to its population than is the case in the other and more stationary parishes.

1. The "well-to-do" district occupies the eastern, central, and higher portions of the city, with a general height of 140 feet above the level of high-water mark; is situated on the trap, and new red sandstone formations, more particularly the former; abounds in good springs, and its drainage easy, as far as natural position, and well effected as far as artificial means are concerned. It is occupied almost entirely by inhabitants who have the means of enjoying with tolerable ease the necessaries and comforts of life, at the same time they are not entirely free from the anxieties and care of providing for their own subsistence. This population finds its type in the established and thriving tradesman and his various assistants.

2. The "poor" district occupies the south-western declivities of the city. It is situated entirely upon the new red sandstone. The upper and smaller portion is about 100 feet above high-water mark; the lower and greater portion not more than 30, and situated, much of it, upon diluvial soil. The natural drainage of the upper part easy, but of the lower part difficult. Artificial efficient drainage has not been provided. It comprises within its limits a large population, of which by far the greater proportion are crowded together in small and ill-ventilated apartments, and are deficient in many of the ordinary comforts of life. The population of this district was somewhat different in 1800; at that time much of the staple manufacture of the city was carried on within its boundaries, and it contained as inhabitants many of the wealthy merchants. This character has now, however, entirely left it.

3. The "mixed" district occupies the remaining parishes of the city. It forms a semicircle round the other two districts, commencing at the

north and goes round by the east to the south. Its north-western portion is on the shillet, and the south-eastern on the new red sandstone; it is for the most part very favourably situated for drainage, and provision for this purpose has been well carried out. It is occupied indiscriminately by gentry, tradespeople, workpeople, poor, &c.; in fact, comprises all classes of the community.

The parish of St. Sidwell, from its locality and class of population, essentially belongs to this district, and is only saparated from it for the reason above named. It occupies the south-eastern suburb of the city, is on high ground, ranging from 100 to 130 feet above the high-water level. It comprises a large proportion of wealthy and other inhabitants, and from its very rapid increase presents many of the characters of a new district, having increased in population far beyond the average of the city. In this parish is situated the workhouse.

Such, then, are the districts into which Exeter may be divided for the purposes of a sanatory inquiry; we shall now proceed to examine the circumstances attending their population, during the periods of 1800 and 1831; and, by comparison, estimate more particularly the influence certain localities and conditions may have upon the rate of mortality.

TABLE VII.—The POPULATION and ANNUAL MORTALITY, PER CENT., of EXETER divided into DISTRICTS, in the Years 1800 and 1831.

		Houses inhabited.		Population.			Annual Mortality per Cent.		
		By how many Families.	By how many Individuals.	Males.	Females.	Total.	Males.	Females.	Total.
Well-to-do district	1800	1·29	7·13	864	1,213	2,077	1·58	1·15	1·33
	1831	1·32	7·38	923	1,278	2,201	1·32	1·02	1·23
Poor district	1800	1·58	6·22	1,641	2,133	3,772	2·52	2·19	2·34
	1831	1·96	8·38	2,994	3,303	6,297	2·83	2·47	2·64
Mixed district	1800	1·44	6·65	3,565	4,706	8,271	2·52	2·01	2·23
	1831	1·42	6·78	6,008	7,134	13,142	2·41	1·87	2·11
St. Sidwell	1800	1·53	6·01	1,072	1,635	2,707	5·69	4·64	5·06
	1831	1·30	6·17	2,758	3,844	6,602	3·28	2·22	2·52
Exeter	1800	1·47	6·49	7,142	9,687	16,827	2·88	2·38	2·58
	1831	1·43	6·96	12,683	15,559	28,242	2·63	2·02	2·39

Without going into detail upon the numbers dying annually per cent. at these two several periods in the different districts above noted, it may be stated generally, that in the "well-to-do" district, in 1831, the population had only slightly increased over that of 1800, and that not particularly by the extension of houses, but by more living in each house, and we also may observe, that the mortality is somewhat less; in the "poor" district the population had considerably increased, was more crowded, with a higher registered rate of mortality; that in the "mixed" district the population had, during this period, increased even ina greater proportion, and spread over a larger surface with a rate of mortality much decreased; that in St. Sidwell the population had likewise increased by the occupation of new ground, having, from its position without the ancient boundaries of the city, ample space for so doing, the table exhibits the mortality at this later period as strikingly decreased, this may be somewhat explained by the presence in this parish of the workhouse, devoted to the reception of the poor of the whole city; as, probably, in this institution nearly the same amount of death took place in 1800, with a population of 2707, as, subsequently, in 1831, with the increased population of 6602, and, therefore, necessarily inordinately increasing the ratio of mortality of the earlier period. Such, then, are the more striking results of a comparative view at these two periods of the physical condition of these districts, together with the state of their population and ratio of mortality, and we see that it strongly proves that an ill drained condition of the town, combined with a deficiency of water, is highly injurious to life; that this is made evident on the one hand by the decrease in the ratio of mortality in the " well-to-do," " mixed," and St. Sidwell's districts, which had all benefited by the improvements of sewerage, &c., while it is more strongly proved by the increased ratio of mortality in the " poor" district, as this presents, without any corresponding improvements, a denser population, and one otherwise deteriorated by the absence of their former rich residents. With regard to this population, it should also be noted, that the chief change, as regards employment, had taken place, for this district was peculiarly the locality of the artisans engaged in the various branches of woollen trade; wherefore we may fairly conclude—

II. That whatever may have been the influence upon life of the manufacture of Exeter, that the chief and prominently injurious cause is deficient drainage, deficient supply of water, and deficient ventilation.

It is to be regretted that these statements and conclusions have been made solely upon the gross amount of mortality without reference to age; it would have been infinitely more satisfactory if the ages of the dying could have been compared together; as far as the registers of 1831 are concerned, this point could have been ascertained, but the total absence in 1800 of the registration of the age of death, with the exception of one single parish, renders such a comparison impossible. In the parish of St. Mary Major, the age of every death is apparently most accurately recorded; it will therefore not be uninteresting to state here the age at death in this parish at both these periods; before doing so, however, it will be necessary to clearly and fully understand the exact position of this parish at these two several periods. In 1800, St. Mary Major contained a population of 2135, including, together with poor, a large proportion of respectable people; the houses were ample, containing on the average each 1·84 families and 7·14 persons; it was in fact then far from a very poor parish. In 1831, its population had increased to 3516, and with this its wealth and respectability had decreased—in fact, now inhabited chiefly by poor if not by paupers. The houses had become more densely peopled, containing on an average more than two (2·11) families and nine individuals in each. With regard to drainage and the supply of water, much the same condition prevailed at both periods. Having premised this, we now add the mortality at different ages in these two periods:—

Table IX.—The Mortality per Cent. of St. Mary Major's Parish in 1800 and in 1831, arranged at the different Years of Death.

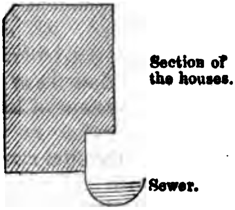
Years.	Under 10.		10 and under 20.		20 and under 30.		30 and under 40.		40 and under 50.		50 and under 60.	
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
1800	25·90	22·05	1·63	1·90	2·37	3·83	2·18	2·55	3·28	4·19	2·73	4·37
1831	27·94	21·83	2·94	1·96	1·31	3·16	3·93	3·38	2·72	2·83	3·93	3·82

Years.	60 and under 70.		70 and under 80.		80 and under 90.		90 and upwards.		Total.	
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
1800	2·91	5·10	4·01	6·56	1·45	2·55	0·36	0·91	46·89	53·10
1831	3·27	5·67	1·63	4·91	1·52	1·96	0·10	1·09	49·84	50·65

Table X.—The Mortality of St. Mary Major's Parish in 1800 and in 1831, showing the Numbers Living and to Die at each Period of Life.

There are living out of every Huudred who die.		
At years of age.	In 1800.	In 1831.
10	52·05	50·23
20	48·52	45·33
30	42·32	40·86
40	37·59	33·55
50	30·12	28·00
60	23·02	20·25
70	15·01	11·31
80	4·44	4·77
90	0·40	·29

On looking at these tables, as well as at Tables I. and IV., we find in the latter and worse period of the parish, both the deaths per cent. and the deaths at different ages characterize it as liable to a much higher rate of mortality than in 1800; that the mortality is greater by a very considerable amount in the earlier periods of life, and less from an extinguished population in the latter; so that we have here a very strong and remarkable confirmation of the deduction, that the chief sources of excessive mortality are the crowding together masses of population into situations ill ventilated, ill drained, and badly supplied with water. Such, then, in 1831 was the condition of one large parish; nor were there wanting in different parts of the city smaller and more isolated spots in which an equally bad, if not worse, state of things existed; and though from the absence of a correct registration no accurate data can be quoted, yet my own personal conviction is strong with regard to them; they constituted serious plague-spots in the history of the city at this period. As an illustration of this statement, I will quote the condition of a court in the parish of St. Olave, and a row of houses in the parish of St. David, especially as an alteration in their condition has been attended by beneficial results. Hick's-court, so late as 1832, was a little nest of disease, cases of fever constantly occurring amongst the adults, and diarrhœa amongst the children; and that at times when neither of these affections were prevalent in the neighbourhood. My attention was directed to the state of the drains, which were so badly constructed as to render the atmosphere of the whole court foul and stinking; on this nuisance being obviated, immediately its unhealthy character subsided, and I am not aware that any peculiar sickness indicating it to be an inordinately unhealthy locality has prevailed in it since that time. Rockfield-place, consisting of a row of houses, was built adjoining to, and in part projecting over, one of the great open sewers of the city, their windows looking over it, as shown in the accompanying rough sketch. The inhabitants of these dwellings constantly suffered from fevers of a bad type, and the deaths from cholera on the occasion of the visitation of this disease in 1832, and on its sporadic occurrence in 1833, were proportionably very great; so much so that the attention of the Commissioners of Improvement was directed to remedy this unhealthy state of things, and the drain immediately beneath the houses was in consequence covered. From this time the very peculiarly unhealthy character of the locality has disappeared.



The existence of these and similar serious nuisances, together with the still insufficient drainage and inadequate supply of water, being generally felt, and the advantage of remedying them appreciated, strenuous endeavours for this purpose were made; consequently we find the powers of the Commissioners of Improvement were, by an Act passed in 1832, very much extended; and that in 1833, by another Act, a water company was established. The latter Act provides for a plentiful supply of water to the city; the former reciting that the Act of 1810 is insufficient for the enlarged and increasing wants of the city, provides for its better cleansing, lighting, and general improvement; the provisions of this Act are most ample, and, amongst a number of other matters, provides that roadways may be improved, streets widened, wells sunk, that all refuse water should go into drains, that sewers shall be generally provided, and that occupiers of houses must communicate with them; that these private communications must be properly made, that no filth is to be thrown into the sewers, that sufficient scavengers shall be provided, that slaughter-houses shall be removed, that animals should not be kept within the city, that the gas-washings should not be thrown into the water-courses of the river, that they may provide burying-grounds without the city, &c. &c. The occurrence of the Asiatic cholera, with its great attendant mortality in 1832, and to a lesser extent in 1833, so stimulated the public mind, that the provisions of these Acts were most industriously carried out; and this brings me to another epoch in the history of the city.

A.D. 1841.—EXETER CONSIDERABLY IMPROVED, WELL SUPPLIED WITH WATER, A GOOD AND EXTENSIVE SYSTEM OF UNDER SEWERAGE: POPULATION, THOUGH CONSIDERABLY INCREASED, NOT MORE DENSE.

The character of the town at this period was very different from that of 1800, and greatly improved since 1831. Of these improvements we shall now proceed to make some mention. In different parts of the city many new roads had been made, more particularly through the denser and poorer districts; and, in several instances, increased ventilation had been provided by the pulling down of houses which crossed street openings, &c. A large and effective system of drainage was established; the surface gutters, save as communications to carry off rain water into the sewers, had almost disappeared, and the houses generally were supplied with closets and communicated with the drains, independently of which an ample and effective supply of water was provided. Of some of these matters we shall now proceed to speak more particularly. Before doing so, however, it may be as well to observe that there is no public survey of the town, either as regards a general system of levels or the position of the great line of sewers, so that there exists no recorded source to which a public surveyor or private individual can apply in order to repair, enlarge, or form connexion with the public sewers; any information that may be required on these points can only now be derived from the individual who so ably fills the situation of Surveyor to the Commissioners of Improvement; without him the deficiency of a public and authentic survey would be most seriously felt. For the marking in of the drains on the map, by which I have been enabled to describe their course more accurately, I am indebted to the kindness of Mr. Whitaker.

The general surface of the city is now sufficiently even, and enjoys, for the most part, a proper inclination for the discharge of surface-water; nevertheless it is not difficult to find stagnant pools and accumulations of filth, but they generally occur within the boundaries of what is esteemed or really may be private property, and as such, though contrary to the spirit and letter of the local Act, are injudiciously treated as beyond the interference of the local surveyor.

Drainage.—The plan of under-drainage is now very efficient; nearly all the streets have sewers, and where requisite, branch-drains are generally made. Though there may be room for some few additional sewers, yet, take it altogether, the city is well provided in this respect. Of the great extension of sewerage within the last ten years, some idea may be formed from the fact of the Commissioners of Improvement having expended upwards of 7000*l.* upon this item alone. The communication with these sewers is almost general; nevertheless the contrary is the case in many of the poorer houses; and though there is in the local Act the power of compelling this, yet unfortunately it provides that the communication shall be made by the occupier and not by the proprietor, so that in many cases, though the Act enables the occupier to deduct the expense so incurred from the rent due to the proprietor, yet experience shows there is so much difficulty in enforcing this provision, that it too often, where most desirable, amounts to a nullity. Where communication has been made, the branch drains are for the most part well kept, and have a sufficient supply of water for their frequent cleansing; though doubtless there may be many examples to the contrary, from carelessness in the inmates throwing down choking articles, or the breaking in of the work itself. In the public sewers, excepting from some rare casualty, nothing of this kind occurs; they are constructed on sound principles, with sufficient inclination, and well furnished with stench-traps; now and then in the course of a long drought, or on the stench-traps becoming dry, offensive effluvia may be emitted from them; but, generally speaking, they may be considered as well constructed in these respects.

Such, then, is the public provision for the drainage of the city; and, by its means, the entire of the liquid refuse may be said to be carried off; only in some by-corner or out-of-the-way place is such allowed to soak into the subsoil, or remain stagnant on the surface. The general character of the system of drainage followed in Exeter results from its natural position, and will easily be understood from the accompanying plan and sections. The principal drains are constructed of masonry and brick work, varying from three to five feet high, and two to four feet wide in the clear; they are arched over with inverted arch bottoms, so that they nearly represent the shape of an egg; the average cost is about 7*s.* per foot. The drains which communicate from the different streets are gun-barrel brick drains, of the various sizes of 2 feet, 1 foot 9 inches, 1 foot 6 inches, 15 inches, and 12 inches, according to circumstances; the price of construction for these varies from 1*s.* 6*d.* upwards per foot. These sewers are, during the winter, kept clear and well washed out by the copious rains of the season; in summer the Commissioners of Improvement pay the water company for a supply of water for this purpose, and once or twice a week they are washed down from this source. The surface dirt, soil, contents of ash-pits, &c., in all the public ways, are removed daily under the direction of the Commissioners. In the less accessible courts and alleys the collection of dirt is regulated by the probability of the accumulation; generally speaking, however, it is done twice a-week; it is not permitted to be thrown into the street, but is brought out in boxes, which the scavengers empty into their carts. There are some few places in the back lanes where the air may be tainted by vegetable matter being allowed to accumulate and putrefy; but this is by no means a general case, and is rather due to idleness on the part of those permitting it. More inconvenience is suffered from the keeping of pigs and the presence of slaughter-houses; both these nuisances are most urgent, and prevail to a greater extent than is generally supposed, and, by the poor obliged to live within their influence, are much complained of; cases frequently occur of serious fevers, nervous pains, and sickness of stomach, which they refer entirely to "swallowing" bad smells from these sources. The filth collected by the scavengers is carted away into three or four places at some little distance from the city. The scavengers receive for this service 50*l.* per annum, in addition to the proceeds of the sale of the manure so collected, and which yields, on an average, upwards of 500*l.* per annum. The Commissioners of Improvement have, under their Act, ample powers to "order and direct any prosecution against any person or persons, bodies politic or corporate, for any public nuisance whatsoever."

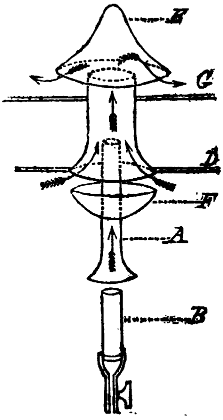
Houses.—With regard to houses and their construction, there are no controlling or directing powers vested in any public body; they are built according to the plan and wishes of the proprietor; for the most part, those erected for the poorer classes are not so insalubrious as might, under such circumstances, have been supposed. I believe there is no such blot in this city as cellar habitations, unless kitchen apartments may be so considered; nevertheless minor faults may be found with the construction of many of the tenements, and that too in some of those in the recently erected streets. In many of these the houses are placed back to back, or have their windows opening only on one side, thus preventing ventilation and a free current of air. Another very prevailing error is the adoption of sash windows, the upper sash not being made to open. Though the effect of many of the recent acts of the Commissioners has been to relieve the overcrowding of the town districts, and thereby cause the advantageous extension of the suburbs, they possess no power by which so useful a measure can be guided and regulated. New buildings may crôss the ends of old streets, though they have the power of preventing the streets from being closed at the ends.

School-rooms.—The public school-rooms for the poor are well situated as regards site, drainage, and light; the provisions for warmth and ventilation, though not particularly to be found fault with, are not so ordered as to deserve notice; they have necessaries attached to them, which are but too frequently the source of complaint from their managing committees; their play-grounds are inconsiderable, they may almost be said to have none. The private or "dame" schools for the poor, are a fruitful source of an injuriously bad atmosphere. The rooms appropriated to this purpose are usually in crowded and bad situations, small, and inhabited by the mistress day and night, with the addition of a fire, winter and summer, for culinary purposes; in an atmosphere thus artificially heated, are congregated together for hours in the day, perhaps 20 children. The closeness and unpleasantness of these rooms is scarcely credible; they may really be termed modified "black holes." The effect upon the children is seen in the breaking down of otherwise strong constitutions, and the development of much active scrofulous disease; but the injuriousness of these schools is more directly witnessed on the occasion of any infantile epidemic; they not only become nuclei for the propagation of disease, but the poison is so concentrated, and therefore active, that not only do very few escape infection, but those infected suffer most severely.

Independently of the want of play-grounds attached to the schools, there is a great deficiency of open spaces about the city for exercise. Save the Northernhay and the Cathedral-yard (where the police interfere with the playing of boys) and the open roads of the neighbouring country, it may be said that there are neither play-places, parks, gardens, nor walks.

Bathing.—The extension of the town is also gradually depriving the inhabitants of places contiguous to it, where the custom of bathing has long been enjoyed; this is an important consideration for all classes, but more especially for the poor; experience has always shown that they have gladly availed themselves of the means of cleanliness so afforded; and it is not for me now to urge that cleanliness conduces directly to bodily health, as well as acts beneficially on the general character.

Burying-grounds.—The crowded state of the public grounds of the city had long been felt as a serious and offensive nuisance; accordingly, in 1835, the Commissioners of Improvement provided a large and suitable space of ground without the city wall for the purposes of interment, and at the same time prohibited the opening of new graves in the old ground. There however still exist some minor blots of the overcrowding of grave-yards, the most disgraceful of which is the present burying-ground belonging to the parish, and surrounding the church of St. Sidwell. It is to be hoped that some general Act will obviate the continuance of this evil.



Gas is generally introduced and much used throughout the city; but no provisions of any kind are made for the ventilation of the air vitiated by its use, excepting at the Devon and Exeter Institution, where a plan devised by P. C. De la Garde, Esq., has been attended by great practical success. A tube (*A*) an inch in diameter, having a trumpet mouth, is suspended immediately over the glass chimney (*B*) of an argand gas-burner. The upper part of this tube enters for about a foot into a tube of similar shape (*C*) but of double the diameter. The lip of the trumpet mouth of the larger tube is exactly level with the ceiling (*D*), the upper end passing through the roof (*G*) is protected from rain by a conical cap (*E*). The column of hot air discharged by the glass chimney passes through the smaller tube with great velocity into the larger tube, in which, partly by rarefaction, and partly by direct impulse, it occasions a rapidly ascending current; whilst, therefore, the smaller tube carries into the larger tube all the air vitiated by combustion, the larger tube discharges through the roof not only the air which is received from the smaller tube but also the air vitiated by respiration or other causes, which it sucks up from the upper part of the room. The inconvenience resulting from the condensation of moisture in the upper tube during cold weather is obviated by its being caught in a vessel (*F*) which surrounds the smaller tube immediately below the mouth of the upper one. This simple and effective apparatus is made of copper. During upwards of seven years that it has been constantly in use it has required no cleansing, reparation, or indeed attention of any kind whatever.

Water-works.—With regard to water for domestic purposes, independently of the old supplies from wells, &c., the conduit and the newly-established water-works require mention. The supply from the conduit had for a few years previously to 1835 been gradually diminishing, when it then almost ceased to flow; at the same time the supply, from the same source, to the houses of the dean and chapter was greatly reduced. At the request of this body, and the then Chamber, Mr. Golsworthy kindly undertook to investigate the cause of this deficiency. He found that the water was collected and ponded in the spring wells to a height of between nine and ten feet, without obtaining a sufficient elevation for being forced over some required points. By this ponding a large quantity of water escaped, and was wholly lost. Mr. Golsworthy's first object was to remedy this great and radical defect, by lowering the high points, sinking the wells much deeper, and opening and clearing the springs. He thus succeeded in bringing the water into the wells, and re-establishing the ancient supply, the benefits of which are now rendered more available by the establishing of the conduit in an open space, near the lower market, and by delivering it at a new spot in Mary Arches-street. But the great and manifest improvment in the suply of water is found in that afforded by the water company, a joint-stock corporation, formed under Act of Parliament in1833; from a large reservoir made by them under the direction of the late William Anderson, Esq., C.E., it may be said that an unlimited supply of this most necessary article of life is afforded. This reservoir, which occupies a spot to the north of the city known by the name of Dane's Castle Field, is now 200 feet square and 17 feet deep, and is supplied with the water of the river Exe, taken from a mill-leat, two miles from the city, and above the junction of the Creedy; it is, therefore, in great measure free from any adventitious impurities. The qualities and chemical composition of this water have already been given.

The first erected engine is worked by a breast-wheel of 23-horse power, with 48 buckets, 13 of which are equal to one stroke of the pump; it has three pumps, each of which gives 18 strokes to a minute. The water thus delivered in this space of time at the reservoir is 37 cubic feet, or 438 gallons. The reservoir is 160 feet above high-water mark, but the water could be raised by the stand-pipe, which was 150 feet above the level of the river at Pynes Weir, to the further height of 180 feet. On ordinary occasions, however, the number of strokes in a minute at which these pumps are worked is 14 each, to force the water into the reservoir, and 10 to the higher level of the stand-pipe. It was early found, notwithstanding the great extent of the supply thus afforded, that it was inadequate to the wants of the inhabitants; therefore, in 1841, a new wheel and pumps were added, the reservoir was enlarged to its present capacity, and the stand-pipe considerably elevated. The new wheel is of 17-horse power, and has 40 buckets, of which 11 are equal to one stroke of the pumps. The new pumps are three in number, and each gives 14 strokes in a minute at its usual work. The height of the stand-pipe is now 13½ feet above the level of the water in the reservoir, and its valve is weighted to raise the water 50 feet. The higher pressures are supplied independently of the reservoir. The advantage derived from these additions and improvements will be fully appreciated when it is stated that, on a trial being made by working the new and old pumps together, the water flowing through the safety valve of the stand-pipe and falling into the reservoir, each set of pumps making 11 strokes per minute, the quantity of water delivered into the reservoir by gauge was 23,748 gallons in one hour; on another trial, the water being delivered to the lower level of the reservoir, the new pumps making 17 strokes to the minute, and the old 11½, the quantity of water forced in was 33,122 gallons in one hour; so that the higher level of the stand-pipe decreases the power of the pump by about one-third. By experiments made in different places, it was shown that water could be delivered from the pipes 30 feet above the highest levels of the city. One cause of failure in the old pumps, and which had not been foreseen, was excessive floods "tailing" the wheel, to such an extent as to cause material obstruction. By an experiment on the new and old wheels, during some high floods, it was found that while the old wheel was two feet in tail water, and the pumps making but 10 strokes per minute, the new wheel had only six inches in tail water, and the pumps were making 21 strokes per minute; so that the new wheel will be only affected by severe floods, and then but for a few hours.

The quantity of water now supplied to the inhabitants of Exeter and its vicinity is 6919 hogsheads daily, (about 12 gallons per head,) the cost of which to the consumers, according to the amount of rents paid, is little more than one farthing per hogshead, and at this trifling price it is supplied to many houses at a considerable elevation. The waste consequent upon this vast consumption is of the greatest service in preserving the health of the city, by cleansing and washing out the sewers, &c. The mode in which the water is distributed over the city is through iron pipes, and from them by leaden supply-pipes into cisterns, furnished with ball-cocks. In some particular cases the cisterns are supplied directly from the mains. Of the 5122 houses of which Exeter is composed the water is supplied to 3400; the number of customers, however, is about 2600, the deficiency of 800 being made up of tenements closely packed together, which are supplied, never from the stand-pipe, but from one common cistern, usually at the landlord's expense, who is charged by the company at a rate of from 2*s.* to 4*s.* per annum for each family. This supply is so easy and so generally furnished that it is only in a few cases the people have recourse to pumps or draw-wells, and in still rarer instances do they beg of distant renters. That this supply is duly appreciated may be learned from the fact, that 98 families out of every 100 who consume the water now have it in their houses; in fact, in some of the very poorest there may be seen in the corner of the room a small cask, with ball-cock, to receive the supply, and they invariably speak of it as being the greatest comfort, and as well worth the money it costs them. Notwithstanding this apparently very favourable account, there is yet much room for improvement; for if we assume, in the absence of any such statement in the census of 1841, that the number of families in Exeter are in the same proportion to the population as they were in 1831, they will amount to 7000, so that there are only, of the whole population, about one-third who have it in their houses, and only about half who are consumers of it.

The supply, quality, or price of the water is rarely the object of dispute amongst any class of the consumers; the quality never, the water being clear, good, and requiring no filter; now and then there may be accidental and private disputes as to supply and price, but they do not amount to any crying or grievous importance. With regard to quantity, the supply is supposed to be unlimited, while the price is calculated at a general average of a shilling in the pound, according to the value of the house supplied. The rental of the company is about 4000*l.* per annum, the rateable value of the city is 133,448*l.*; therefore, taking the whole city, not more than 7*d.* in the pound is paid. Though each renter is charged about 1*s.* in the pound, there are yet, under particular circumstances, many deviations from this rule. Should any disputes arise in reference to the administration of the company, application is to be made to the committee, appointed under Act of Parliament. With regard to price, the Act itself provides a maximum, which has never been nearly attained by the company. Excepting from the committee, no remedy against grievances can be obtained.

Connected with the mains is an extensive system of stand-pipes, placed at convenient distance over the city, and from which the water is taken for the public purposes of watering and cleansing the streets, &c. The water is turned into the tenants' supply-pipes three days a-week, for the space of three hours, and is kept on the mains themselves during the whole of the day; at night it is shut off from a convenient place within the confines of the town (near the New London Inn), so that, in case of sudden emergency, such as the occurrence of fire, it can immediately be permitted to flow into the mains of any part of the city. It is usually available, in full supply, in about ten minutes. The supply is always kept on at high pressure, and could on these occasions, if required, be thrown over the houses, direct from the pipes themselves; but this practice is not deemed advisable, as in such case it would be necessary to open only one plug; it is therefore preferred to supply the fire-engines, and for them to deliver it. The town is furnished with five well-appointed and practised engines, and the service of the firemen is exceedingly good. This, together with the ample supply of water, and its general and efficient distribution, has prevented the necessity of any special arrangement for the protecting of particular buildings. Fires are, happily, not frequent; there rarely occur, on the average, more than two in the year, and these are generally due to domestic or accidental causes. In case of its occurrence, however, serious alarm is always entertained for surrounding property, as it is by no means the practice amongst the builders to make party-walls, or otherwise to provide against the occurrence of neighbouring fire.

From the previous account it is plainly seen that the condition of Exeter in 1841 is most materially improved since 1800, and even since 1831, in all the essential requisites of a large city, but that it still retains within itself much that is obnoxious to health. In order to appreciate the effect of these improvements, and of the remaining presence of nuisances, upon the duration of the life of its inhabitants, we shall proceed to consider the state of its population, and the comparative amount of its mortality in the different districts of the city at this period. According to the census of 1841, the population amounted to 31,333 (13,842 males and 17,491 females); being an increase of 3048 since 1831, and of 14,506 since 1800. In the following table the absolute population and proportional increase per cent. is set out.

TABLE XI.—The POPULATION of EXETER, in 1800, 1831, and 1841, and its Proportional Increase upon itself.

—	Absolute amount of Population at the undermentioned Years.			Increase of Population upon itself per Cent.	
	1800	1831	1841	From 1800 to 1841	From 1831 to 1841
Males . .	7,142	12,683	13,842	93·81	9·13
Females .	9,685	15,559	17,491	80·59	12·42
[illegible] .	16,827	28,242	31,333	86·20	10·97

TABLE XII.—The POPULATION of EXETER in 1841, with the ACTUAL MORTALITY for Five Years, and the AVERAGE ANNUAL MORTALITY per Cent., exclusive of the Hospital and Workhouse.

1841.	Houses.		Persons.			Actual Mortality from 1838 to 1842.			Average Annual Mortality per Cent.		
	Inhabited.	Uninhabited	Males.	Fem.	Total.	Males.	Fem.	Total.	Males.	Fem.	Total.
St. Martin	40	3	93	161	254	7	7	14	1·50	0·86	1·10
Bedford Precinct	24	1	35	84	119	5	5	10	2·85	1·19	1·68
St. Petrock	45	6	109	158	267	5	7	12	0·91	0·88	0·89
St. Stephen	73	.	183	294	477	16	11	27	1·74	0·74	1·13
All Hallows, Goldsmith-street	50	4	151	209	360	7	13	20	0·92	1·24	1·11
St. Lawrence	100	14	300	341	641	26	27	53	1·73	1·58	1·65
Total	332	23	871	1,247	2,118	66	70	136	1·51	1·12	1·28
St. Edmund	237	19	737	858	1,595	117	118	235	3·17	2·75	2 94
St. Mary Major	426	18	1,586	1,910	3,496	239	216	455	3·01	2·50	2·60
St. Mary Steps	205	22	618	638	1,256	84	80	164	2·71	2·50	2·61
Total	868	59	2,941	3,406	6,347	440	414	854	2·99	2·43	2·69
The Close	106	5	287	410	697	31	48	79	2·16	2·34	2·26
St. David	572	67	1,595	1,913	3,508	187	182	369	2·34	1·90	2·10
St. John	86	7	220	280	500	22	31	53	2·00	2·21	2·12
St. Kerian	91	8	192	210	402	11	27	38	1·14	2·57	1·89
St. Mary Arches	93	13	304	347	651	33	33	66	2·17	1·90	2·02
St. Pancras	81	6	170	193	363	19	24	43	2·23	2·48	2·36
St. Paul	213	19	653	745	1,398	72	75	147	2·20	2·01	2·10
St. Olave	217	3	416	496	912	34	60	94	1·63	2·41	2·06
St. George	142	13	308	377	685	56	53	109	3·63	2·81	3·18
Trinity	605	44	1,562	2,055	3,617	157	196	353	2·01	1·90	1·95
All Hallows-on-the-walls	173	15	389	478	867	51	41	92	2·62	1·71	2·12
Total	2,379	200	6,096	7,504	13,600	673	770	1,443	2·20	2·05	2·12
St. Sidwell	1,533	161	3,684	4,973	8,657	438	497	935	2·37	1·99	2·16
Exeter	5,112	448	13,592	17,130	30,722	1,617	1,751	3,368	2·45	2·04	2·19

Table XI. shows while the increase is very remarkable from 1800 that it is by no means so since 1831; and as, by reference to the Table XII., we see, during this period, an increase of 2370 has taken place in the suburban parish of St. Sidwell, 435 in the suburban parish of St. David, and 1025 in the suburban portion of Trinity, an increase in these three parishes alone of 782 more persons than the increase of the whole city, Exeter must consequently be less densely inhabited than it was in 1831. As a whole, however, it presents a remarkably stationary population. Nevertheless, in many of the parishes themselves a considerable difference has taken place, the population of some having increased while that of others has considerably diminished. Amongst these latter are St. George, St. John, All Hallows Goldsmith-street, and St. Paul's, chiefly due to the pulling down of houses to make room for the capacious markets erected in these parishes. I should have wished to have compared the mortality of this period with that of the two previous epochs to which reference has been made, but for any very accurate or satisfactory results this is out of the question, as the previous ratio of mortality was deduced solely from the parish registers of burials, while this of 1841 is taken from the more improved and comprehensive returns of the Registrar-General, which, unlike those of the former, includes all deaths of the unbaptized, of those buried in Dissenting grounds, and the deaths in hospitals, &c. &c. We may, however, observe that, notwithstanding this improved mode of registration, the average mortality per cent. of the whole city in 1841 is 2·45, an amount considerably less than that of 1800 (2·58), and scarcely more than that of 1831 (2·39), so that, looking at the relative value of the different registrations, we may fairly conclude that the mortality is now considerably less than at either of the previous periods. We shall now turn to the consideration of the duration of life in the different districts of the city during the period of 1841, and, by comparing their mortality, endeavour to estimate the influence which locality, poverty, crowding together, &c., may have upon life. In the preceding table the population and mortality are set forth.

By reference to the same table we may observe that the average annual mortality per cent. of the different districts of Exeter is thus stated,—

Districts.	Average Annual Mortality per Cent.
Well-to-do .	1·28
Poor . . .	2·69
Mixed . .	2·12
St. Sidwell's .	2·16

This table shows results which mark most strongly, when the character of the districts is called to mind, the much greater value of life in those which are roomy and well ventilated over those that contain a crowded population, and are occupied by squalor and misery. In order, however, to show this more satisfactorily, the absolute mortality, and the mortality per cent. at different ages of life in these different districts, are, in the following tables, fully set forth. (Tables XIV. and XV.)

From the above tables the mortality occurring in Exeter and its districts may be appreciated, but as they are not, without some application, easily to be read off and compared, the following table and diagram are constructed, showing out of every hundred persons that die the numbers living at each age.

TABLE XIII.

	Of every 100 that die in Exeter and its different Districts, there are living in				
	Well to do.	Poor.	Mixed.	St. Sidwell.	Exeter.
At 1 month	95·60	97·33	96·68	95·95	96·84
1 year	83·85	75·92	82·90	78·64	81·39
5 years	61·80	49·46	62·88	57·26	61·03
10 ,,	55·93	43·73	57·69	52·03	55·50
15 ,,	52·26	42·80	56·45	50·66	53·91
20 ,,	50·06	41·41	54·10	48·85	51·90
30 ,,	39·78	36·39	46·97	42·66	44·70
40 ,,	36·11	32·53	39·14	36·07	37·75
50 ,,	25·83	27·27	33·05	28·92	30·49
60 ,,	20·69	19·91	27·44	23·69	24·00
70 ,,	13·35	11·02	18·51	15·25	15·48
80 ,,	4·54	5·06	7·50	6·49	6·52
90 ,,	..	·74	1·62	4·91	1·36
100 ,,	..	..	·38	1·27	·40

TABLE XIV.—The ACTUAL MORTALITY of EXETER, from 1838 to 1842, at different Ages.

Districts.	Under One Month.		One Month & under 1 Year.		1 & under 5.		5 & under 10.		10 & under 15.		15 & under 20.		20 & under 30.		30 & under 40.		40 & under 50.		50 & under 60.		60 & under 70.		70 & under 80.		80 & under 90.		90 & under 100.		100 and upwards.		Total.	
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
Well-to-do District	3	3	8	8	12	18	5	3	2	3	1	2	7	7	3	2	9	5	4	3	3	7	4	5	5	4	.	.	.	.	66	770
Poor District . .	14	9	107	76	113	113	26	23	6	2	4	8	22	21	17	16	23	22	32	31	41	35	18	33	16	21	1	4	.	.	440	414
Mixed District . .	22	26	105	94	147	142	38	37	8	10	9	25	53	50	57	56	47	41	39	42	55	74	63	96	24	61	6	12	.	4	673	70
St. Sidwell . .	21	17	89	73	107	93	28	21	4	9	9	8	23	35	24	38	33	34	23	26	29	50	27	55	15	31	5	7	1	.	438	497
The Workhouse .	5	1	12	15	8	11	4	.	4	2	2	1	10	13	8	16	15	13	12	13	6	9	14	24	7	17	2	.	.	.	109	135
The Hospital . .	.	.	.	2	7	5	12	14	4	7	8	.	24	10	21	7	31	4	18	5	13	3	2	1	.	.	.	.	.	.	140	58
Total of City .	65	56	321	268	394	382	113	98	28	33	33	44	139	136	130	135	158	119	128	120	147	178	128	214	67	134	14	23	1	4	1,866	1944

TABLE XV.—The MORTALITY per Cent., deduced from the DEATHS of 1838 to 1842, arranged in different Ages.

Districts.	Under One Month.		One Month & under 1 Year.		1 and under 5.		5 & under 10.		10 & under 15.		15 & under 20.		20 & under 30.		30 & under 40.		40 & under 50.		50 & under 60.		60 & under 70.		70 & under 80.		80 & under 90.		90 & under 100.		100 and upwards.		Total.	
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
Well-to-do District	2·20	2·20	5·88	5·88	8·82	13·23	3·67	2·20	1·47	2·20	0·73	1·47	5·14	5·14	2·20	1·47	6·61	3·67	2·94	2·20	2·20	5·14	2·94	3·67	3·67	2·94	.	.	.	.	48·52	51·47
Poor District . .	1·62	1·05	12·52	8·89	13·23	13·23	3·04	2·69	0·70	0·23	0·46	0·93	2·57	2·45	1·99	1·87	2·69	2·57	3·74	3·62	4·80	4·09	2·10	3·86	1·87	2·45	0·11	0·46	.	.	51·52	48·47
Mixed District .	1·52	1·80	7·27	6·51	10·18	9·84	2·63	2·56	0·55	0·69	0·62	1·73	3·67	3·46	3·95	3·88	3·25	2·84	2·70	2·91	3·81	5·12	4·36	6·65	1·66	4·22	0·41	0·83	.	0·27	46·63	53·36
St. Sidwell . .	2·24	1·81	9·51	7·80	11·44	9·94	2·99	2·24	0·41	0·96	0·96	0·85	2·45	3·74	2·56	4·03	3·52	3·63	2·45	2·78	3·10	5·34	2·88	5·88	1·60	3·31	0·53	0·74	0·10	.	46·73	53·15
The Workhouse .	2·04	0·40	4·91	6·14	3·27	4·50	1·63	.	1·63	0·81	0·81	0·40	4·09	5·32	3·27	6·53	6·14	5·32	4·91	5·32	2·45	3·68	5·73	9·83	2·86	6·96	0·81	.	.	.	44·67	55·32
The Hospital . .	.	.	.	1·01	3·53	2·52	6·06	7·07	2·09	3·53	4·04	.	12·12	5·05	10·60	3·53	15·65	2·02	9·09	2·52	6·56	1·51	1·01	0·50	.	.	.	.	.	.	70·70	29·29
Total of City .	1·70	1·46	8·42	7·03	10·34	10·02	2·96	2·57	0·73	0·86	0.86	1·15	3·64	3·56	3·41	3·54	4·14	3·12	3·35	3·14	3·85	4·67	3·35	5·61	1·75	3·51	0·36	0·60	0·02	0·10	48·97	51·02

Before proceeding to deduce any conclusions from these tables, it may be well to observe they are not what are usually termed Life Tables. In order to form these, it would be necessary to compare the numbers dying with the numbers living in each district; which latter data, with the exception of the whole city, is not at my service. They are tables of mortality, and, in their present state are useful for exhibiting and comparing the proportional numbers dying at each age in the several districts designated. While using them for this purpose, however, it will be necessary to bear in mind, in order to prevent erroneous conclusions, that they point out the proportional character of the mortality, as regards age, of these districts, and not, what has been previously stated, the comparative amount. With this understanding, these tables will be found to indicate some very striking points. 1. *The whole city.*—A large proportion of the deaths which occur take place before attaining five years of age, (38·97 per cent.); in the next 15 years of life the proportion is but small, and subsequently remarkably even. Though there is a larger proportion of female than male deaths upon the whole (2·05 per cent.), yet rather more males than females die under one month, and considerably more between one month and the completion of the first year. 2. *The well-to-do district.*—The periods in which the greatest proportion of mortality takes place are in the first month, from 5 to 10 years of age, from 20 to 30, and from 40 to 50. Under one year the mortality of the two sexes is equal; between one and five there are more female deaths, as also between 10 and 20; male death is in excess between 5 and 10, and between 30 and 50. 3. *The poor district.*—In the first month of life there is a less proportion of deaths in this district than in any of the others; but between that and the completion of the first year the proportion is very large, as also between 1 and 10; it then continues less until the age of 60, when there is again an increase. The proportion of male over female death upon the whole mortality is 3·05 per cent. More males die under one year, and between five and ten. Between one and five the mortality is about the same in both sexes, and also during the remaining periods of life, there being only a slight preponderance of male death. 4. *The mixed district* presents nothing very remarkable, excepting that the proportion of female over male death is considerable (6·73 per cent.), notwithstanding the general prevalence of a larger proportion of male mortality at each period previously to 50 years of age, when that of female death slightly, and after 60, very greatly increases. 5. *St. Sidwell district* has a greater proportion of mortality under one month, and only slightly less than the poor district between then and the first year, which position it maintains until 50 years of age. Upon the whole deaths there is a larger amount of female (6·42 per cent.) than male mortality; under five years of age, however, a larger proportion of males die, it being after 20 that the excess of female death commences.

As it is commonly said that a fair estimation of the character and force of mortality in any given population may be estimated by the proportion of deaths taking place before 15 years of age, the following table, showing this point, is extracted from those immediately preceding:—

TABLE XVI.—The NUMBER of DEATHS per Cent., in the different DISTRICTS of EXETER, under 15 Years of Age.

	Males.	Females.	Total.
Well-to-do . . .	22·04	24·71	46·75
Poor	30·11	26·09	56·20
Mixed	22·15	21·40	43·55
St. Sidwell . . .	26·59	22·75	49·34
Exeter	24·15	21·94	46·09

From which we see that not quite half the mortality in the whole city, and in the "well-to-do" district, takes place before this period of life; while, in the "poor," far more than half the deaths occur previous to this age. That the "well-to-do" district is not so favourably placed by this table as the "mixed," and is seen to have a less proportion of female mortality than of male, which is contrary to what prevails in the other instances. From the facts above stated, and from the tables themselves, the following inferences may be deduced :—

1. That at infancy, *i. e.* before the expiration of the first month of life, there does not appear to be any particular exemption from casualty enjoyed, on the one hand, by the "well-to-do" district nor any peculiar liability to it, on the other in the "poor" district.

2. That in infancy a larger proportion of males than females die.* Thus supporting the old adage, "that boys are more difficult to rear than girls."

3. That in childhood more males than females die.

4. That in the poor district the period of childhood is liable to a disproportionate mortality.

5. That as there is a much larger proportion of female than male deaths in all the districts of the city, save in the poor district, and in the hospital, which may here be considered as part of it, the occupations of the poor are proportionately more inimical to male than female life.

6. That the poor district is subject to a greater amount of mortality than any other; and that the character of the city, in respect to duration of life, is mainly depreciated by the "poor district, St. Sidwell's, the workhouse, and the hospital."

We shall now turn to a consideration of the effect of climate upon the inhabitants of the different districts of the city. In order to do so the average mortality per cent. for five years is arranged in different months, and then combined into the different seasons, each showing the mortality above and below 15 years of age. (See Tables XVII. and XVIII.)

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* This greater mortality of infant male life appears, however, to be quite independent of local influence, and solely due to physiological causes. This question has been largely examined by Dr. Simpson, who, from extensive statistical observations, concludes the greater amount of male death in infancy is due to the larger size of the male head, causing injury during parturition. From an examination of the Registrar General's returns for the seven years published, he concludes there have been lost in Great Britain, during this limited period, as a consequence of that slightly larger size of the male than the female head at birth, about 50,000 lives, including those of about 46,000 or 47,000 infants, and of between 3000 and 4000 mothers who died in childbirth.

TABLE XVII.—The AVERAGE MONTHLY MORTALITY, per Cent., of EXETER and its Districts, for the Period of 1841.

Deaths.	January.		February.		March.		April.		May.		June.		July.		August.		September.		October.		November.		December.		Total.	
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	M.	M.	F.
WELL-TO-DO DISTRICT.																										
Under 15	2·94	2·20	2·94	2·94	5·14	0·73	0·73	3·67	·	2·20	1·47	0·73	1·47	0·73	0·73	3·67	·	2·94	2·94	2·20	2·20	2·94	1·47	0·73	22·05	25·75
Above 15	5·88	2·20	3·67	0·73	2·20	1·47	1·47	2·94	0·73	1·47	1·47	3·67	1·47	0·73	0·73	1·47	0·73	1·47	1·47	2·94	0·73	2·94	5·88	3·67	26·47	25·73
Total . . .	8·82	5·40	6·61	3·67	7·35	2·20	2·20	6·61	0·73	3·67	2·94	4·40	2·94	1·47	1·47	5·14	0·73	4·40	4·40	5·14	2·94	5·88	7·35	4·40	48·52	51·47
POOR DISTRICT.																										
Under 15	2·69	2·81	2·22	1·28	2·10	2·57	2·92	1·40	2·81	2·34	2·22	1·62	3·16	2·34	4·44	2·92	3·27	3·62	1·40	2·45	1·28	1·17	2·57	1·52	31·14	26·11
Above 15	1·62	2·57	1·87	1·99	2·22	2·22	2·22	1·52	1·75	1·62	1·17	2·22	1·99	1·62	1·05	1·17	0·81	1·40	1·75	1·87	1·40	1·99	2·45	2·10	20·37	22·36
Total . . .	4·33	5·38	4·09	3·27	4·33	4·80	5·15	2·92	4·56	3·98	3·39	3·86	5·15	3·98	5·50	4·09	4·09	5·03	3·16	4·33	2·69	3·16	5·03	3·62	51·52	48·47
MIXED DISTRICT.																										
Under 15	2·63	1·38	1·59	1·66	2·49	1·66	2·21	1·94	1·31	2·14	1·66	1·52	1·87	2·42	1·94	2·42	2·14	2·21	1·59	1·45	1·66	0·97	1·03	1·59	22·17	21·41
Above 15	2·91	3·74	2·35	2·77	2·28	4·08	2·28	2·63	1·87	2·35	2·00	1·80	1·10	2·97	1·87	2·07	1·87	2·14	2·07	2·35	1·59	2·42	2·21	2·56	24·46	31·94
Total . . .	5·54	5·12	3·95	4·43	4·78	5·75	4·50	4·57	3·11	4·50	3·67	3·32	2·98	5·40	3·81	4·50	4·01	4·36	3·67	3·81	3·25	3·39	3·25	4·15	46·63	53·36
ST. SIDWELL.																										
Under 15	2·13	2·78	1·49	1·28	2·13	2·03	2·67	1·92	1·49	1·28	1·92	1·17	1·71	0·96	2·56	2·67	3·31	2·67	2·56	2·03	2·35	1·49	2·24	2·45	26·63	22·78
Above 15	2·13	3·42	2·03	2·35	1·39	2·88	1·49	2·24	1·39	3·42	1·60	1·81	1·92	1·92	1·92	2·67	1·17	2·24	0·96	2·24	1·60	2·35	2·56	2·78	20·21	30·37
Total . . .	4·27	6·20	3·52	3·63	3·52	4·91	4·17	4·17	2·88	4·70	3·52	2·99	3·63	2·88	4·49	5·34	4·94	4·91	3·52	4·27	3·95	3·85	4·81	5·24	46·73	53·15
WORKHOUSE.																										
Under 15	2·45	0·81	2·04	1·22	0·81	2·04	0·81	1·22	1·22	1·22	0·81	0·40	1·22	1·22	1·22	0·40	0·81	0·81	1·22	0·81	·	1·22	0·81	0·40	13·52	11·88
Above 15	3·68	4·91	2·86	2·04	3·27	3·68	2·86	3·68	1·63	3·27	2·86	3·27	2·04	3·27	1·63	5·32	3·68	3·27	2·45	5·32	2·04	2·45	2·04	2·86	31·14	43·44
Total . . .	6·14	5·73	4·91	3·27	4·09	5·73	3·68	4·91	2·86	4·50	3·68	3·68	3·27	4·50	2·86	5·73	4·50	4·09	3·68	6·14	2·04	3·68	2·86	3·27	44·67	55·32
HOSPITAL.																										
Under 15	1·51	4·54	1·51	1·01	1·51	2·01	1·51	1·51	·	·	·	1·01	0·50	·	1·51	1·51	0·50	1·01	1·01	0·50	2·02	0·50	·	0·50	11·61	14·14
Above 15	7·07	1·01	5·05	1·51	5·05	3·03	3·53	2·02	6·56	0·50	4·54	1·51	5·55	0·50	3·03	0·50	2·52	1·51	6·06	·	8·08	3·03	2·02	·	59·09	15·15
Total . . .	8·58	3·55	6·56	2·52	6·56	5·05	5·05	3·53	6·56	0·50	4.54	2·52	6·06	0·50	4·54	2·02	3·03	2·52	7·07	0·50	10·10	3·53	2·02	0·50	70 70	29·29
EXETER.																										
Under 15	2·46	2·20	1·78	1·46	2·25	1·96	2·30	1·81	1·57	1·81	1·70	1·33	1·99	1·78	2·54	2·46	2·44	2·51	1·78	1·75	1·67	1·20	1·62	1·62	24·17	21·96
Above 15	2·80	3·28	2·38	2·30	2·25	3·20	2·15	2·33	1·91	2·38	1·88	2·04	1·81	2·23	1·70	2·12	1·57	2·02	1·94	2·30	1·88	2·36	2·46	2·44	24·80	29·05
Total . . .	5·27	5·48	4·17	3·77	4·51	5·17	4·46	4·14	3·49	4·19	3·59	3·38	3·80	4·01	4·25	4·59	4·01	4·54	3·72	4·06	3·56	3·56	4·09	4·06	48·97	51·02

Table XVIII.—The Average Mortality per Cent. of Exeter, and its Districts, during the different Seasons for the period of 1841.

DEATHS.	Spring.		Summer.		Autumn.		Winter.		Summer.		Winter.	
	Males.	Fem.	Males.	Fem.	Males.	Fem.	Males.	Fem.	Males.	Fem.	Males.	Fem.
Well-to-do.												
Under 15	2·20	6·60	2·20	7·34	6·61	5·87	11·02	5·87	4·40	13·94	17·63	11·74
Above 15	3·67	8·08	2·93	3·67	8·08	9·55	11·75	4·40	6·60	11·75	19·83	13·95
Total . . .	5·87	14·68	5·14	11·01	14·69	15·42	22·78	11·27	11·01	25·69	37·47	26·69
Poor.												
Under 15	7·95	5·36	10·87	8·88	5·25	5·14	7·01	6·66	18·82	14·24	12·26	11·80
Above 15	5·14	5·36	3·85	4·19	5·60	5·96	5·71	6·78	8·99	9·55	11·31	12·74
Total . . .	13·10	10·76	14·74	13·20	10·88	11·11	12·75	13·45	27·84	23·96	23·63	24·56
Mixed.												
Under 15	5·18	5·90	5·95	7·05	4·28	4·01	6·71	4·70	11·13	12·95	10·99	8·71
Above 15	6·15	6·78	4·84	7·18	5·87	7·33	7·54	10·59	10·99	13·96	13·41	17·92
Total . . .	11·28	12·39	10·10	14·26	10·17	11·85	14·27	15·30	21·38	26·65	24·44	26·65
St. Sidwell.												
Under 15	6·08	4·37	7·58	6·30	7·15	5·97	5·75	6·09	13·66	10·67	12·90	12·06
Above 15	4·48	7·47	5·01	6·83	5·12	7·37	5·55	8·65	9·49	14·30	10·67	16·02
Total . . .	10·57	11·86	13·06	13·13	12·28	13·36	11·31	14·74	23·63	24·99	23·59	28·10
Workhouse.												
Under 15	2·84	2·84	3·25	2·43	2·03	2·43	5·30	4·07	6·09	5·27	7·33	6·50
Above 15	7·35	10·22	7·35	11·86	6·53	10·63	9·81	10·63	14·70	22·08	16·34	21·26
Total . . .	10·22	13·09	10·63	14·32	8·58	13·09	15·14	14·73	20·85	27·41	23·72	27·82
Hospital.												
Under 15	1·51	2·52	2·51	2.52	3·03	1·50	4·53	7·57	4·02	5·04	7·56	9·07
Above 15	14·63	4·03	11·10	2·51	16·16	3·03	17·17	5·55	25·73	6·54	33·33	8·58
Total . . .	16·15	6·55	13·63	5·04	19·19	4 53	21·70	13·12	29·78	11·59	40·89	17·65
Exeter.												
Under 15	5·57	9·54	6·97	6·75	5·07	4·57	6·49	5·62	12·54	11·70	11·56	10·19
Above 15	5·94	6·75	5·08	6·37	6·28	7·10	7·43	8·78	11·02	13·12	13·71	15·88
Total . . .	11·54	11·71	12·06	13·14	11·37	11 68	13·95	14·42	23·60	24·85	25·32	26·10

Without going into any detail upon these tables, we shall briefly enumerate the more palpable inferences which may be deduced from them.

1. That looking at the whole population, the winter season is the most hostile to life, and that March and January are the most so to old age.
2. That the summer season is the most hostile to infants and children.
3. That in the "poor" district more die in summer than in winter, and that this excess is due to the enormous mortality of children at this season; that the great and distinguishing feature of the mortality of the poor district is, that while it has not an inferior mortality than that of the city, or the "well-to-do" district, during the winter season, amongst those above 15, its summer mortality is comparatively enormously high under 15.

4. That during each season of the year more males die amongst infants and children; but that the spring is the period more particularly fatal to this sex, excepting in the poor districts, when July and August are particularly obnoxious to male life.
5. That in the "well-to-do" district the males die in the winter and the females in the summer; and that in the "poor," "mixed," and "St. Sidwell" districts, the greater proportion of male death takes place in the summer, and of female in the winter.
6. That in the hospital, during the winter, there is a large proportion of female death in childhood.

We therefore see that, in comparison with the higher well-ventilated and well-drained districts of the city, the poor district is characterised by a more general mortality; that the mortality per cent. is greater; that the amount of death in early life is more; that the summer shows death busy amongst the children, and, the winter, no less so amongst the old people; that of the productive portions of its inhabitants, the males are subject to an undue ratio of mortality; in fact, that in whatever aspect the mortality of the poor district of the city be regarded, it plainly indicates its inhabitants to be subject to a larger amount of death than is proper to the rest of the city. Seeing, then, that the amount of mortality is thus inordinately high, it may be worth while to examine more particularly into the condition and history of the inhabitants of this district than was previously done in describing the districts of the city generally.

As before said, it comprises the parishes of St. Edmund, St. Mary Steps, and St. Mary Major, and occupies the south-western declivity of the city; though some portion of it is sufficiently well situated for drainage and ventilation, yet much of it occupies flat ground, scarcely raised above the level of the river. The great mass of its population are artisans, more particularly shoemakers, and labourers with their families, a very large proportion of whom, during some seasons of the year, are in the receipt of public relief. In the parish of St. Edmund there are two large establishments connected with the preparing of leather: of the workpeople employed in which it may not be inapposite to say a few words. They may be considered under the heads of,—A, *Fellmongers and Tanners;* B, *Leather-dressers and Glovers.*

A. The *Fellmongers and Tanners* comprise fellmongers, beamers or fleshers, tanners and hot-pressers; the first of these is a stinking and wet occupation, the second and third simply wet, and the fourth hot and steaming. The men employed in these several departments are robust, fine, healthy-looking people, eat largely, are liable to no specific disease, and peculiarly free from chest complaints, consumption in particular: a general impression prevails, that fellmongering is a less wholesome department than the others; but, on investigating this opinion, it was by no means substantiated; I could not learn that these workpeople suffered from any particular disease, or that they did not live to equally good ages with the rest. As a remarkable fact, it may be mentioned that neither the tanners nor the fellmongers were attacked by cholera during its epidemic visitation in 1832.

B. The *Leather-dressers* have only to do with the "pelts" after coming from the fellmonger, and their work consists in, 1st, frising;

2nd, oiling; 3rd, washing; 4th, grounding; 5th, stoning; 6th, cutting. The 1st, 2nd, and 3rd, are departments of work that expose to moisture, especially the 1st; the 4th and 5th to dust; and the 6th is in-door work, without any obvious inconvenience. The workmen employed in the 1st, 2nd, and 3rd departments, though looking somewhat pale, are generally healthy, eat largely, are not subject to any specific diseases, and live long. The opinion of the workpeople, amongst whom were some above 70 years of age, was, that few trades were less unhealthy. The departments of grounding and stoning, from keeping the workmen in an atmosphere of dry dust, in No. 4 of leather, and No. 5 of ochre, occasionally produce cough; but this seems accidental, as the cough is not permanent, nor followed by any evil consequences, as consumption, or shortness of breathing. Persons liable to asthma are, however, unable to continue labouring in these departments. Those occupied in the "cutting" are particularly healthy.

The dwelling-houses of this district are, some of them, of ample size, with good rooms, being formerly the residences of the once flourishing merchants of Exeter; others are small, low pitched, with almost inaccessible stairs, and the usual inconvenient characters of the poor Elizabethan house. They are built of the conglomerate, and trap rocks, already described—brick, lath, and plaster—and some few of what is provincially termed "cob." In their construction and relations, the first four present nothing remarkable; the last, however, is peculiar to the West of England, and may therefore be described. The walls are composed of earth and straw, mixed up with water, like mortar, and then well beaten and trodden together. This mixture is always laid upon a foundation of stone work, as it is necessary to keep it dry, hence the Devonshire adage, that "all cob wants is a good hat and a good pair of shoes." The cob mixture is laid on in layers, generally from two to four feet in depth; it is essential that each separate layer should be allowed some weeks to settle, and it is then pared perpendicularly even, before another is added. When the successive layers form walls of sufficient height, the house is roofed in. Some months after the walls are quite finished and supposed to be dry, they are plastered, white-washed, or rough-cast, which provincially is called "slap-dash." This mode of building is much cheaper than stone or brick, and, if kept dry, is very durable.

The aspect of the houses of this district is not very inviting: they present a general appearance of poverty and dirt; nor is this to be wondered at, when it is recollected that of the many rooms composing these houses, one, or at most two, are occupied by separate families; there are, in fact, too many instances of families, consisting of eight, ten, or more persons, having but the limited accommodation of a single room, ranging from 10 to 14 feet square by 9 feet high, in which they sleep by night, huddled together in beds or on the floor, and live by day doing all the household work necessary for so large a number. It may well be supposed that the atmosphere of habitations, such as these, must be unwholesome in the extreme, especially as no provision for ventilation is ever made, and that which might be obtained by eligibility of situation is prevented by the habits and necessities of the people themselves, as the great expense of fuel induces them, in order to economize warmth, to keep their rooms close. Almost the only fuel used is coal, imported from the north, Welch, and, now, the Somersetshire fields, occasionally turf and tan may be burned but not to any great extent. The fire-places are invariably open, and usually consist of a few iron bars set in brick, with unregistered chimneys. The lodging or "trampers' houses," of which there are several in this district, are generally bad, and under no police regulations. The enormous number of both sexes indiscriminately occupying these can only be believed by those who have witnessed the whole floor of a room entirely covered by the beds; and so noisome and disgusting is the atmosphere thus generated, that the "travelling" during day of these people can be the only cause of their not suffering in health. The other nuisances of this district are, a deficiency and ill-construction of privies, the keeping of animals, more particularly pigs, slaughter-houses, with their putrid heaps of offal, middensteads in private courts, and a somewhat deficient supply of water.

The sickness occasioned by this state of things is considerable, and, doubtless, very expensive; and it would be exceedingly interesting to arrive at some exact estimate of its cost, positive and incidental; this is, however, scarcely possible. It would appear, from a general view of the expenses of the poor of the whole city, that about five per cent. (4·94) are registered paupers, that is to say, this number of names appears upon the books; but many women, children, &c., though really paupers, are excluded in the enumeration. The whole of the parishes of Exeter are united for the purposes of rating and giving relief to the poor under the direction of a corporation, constituted by a special Act of Parliament, and, as yet, not interfered with by the Commissioners under the General Poor Law Act. The sum raised by this body, for the year ending May 1844, was 8750*l.*, and the total expenditure 7921*l.* 9*s* 8½*d.* The average number occupying the workhouse is 320; the cost of whom, for bedding, clothing, food, and lesser matters, amounts to 2158*l.* 13*s.*; so that the expenditure for the 12 months' keep of a pauper in the house, exclusive of the cost of salaries, house-rent, &c., is 6*l.* 18*s.* 3*d.* The number receiving out-door money relief is 794 (men 138, women 470, children 186); the gross amount paid to this class of pauper is 3405*l.* 2*s.* 7*d.*, so that on an average each receives 4*l.* 5*s.* 9¼*d.* The number receiving out-door relief in kind is 435, the cost of which relief is 157*l.* 15*s.* 7*d.*, or 5*s.* a-head, and this includes assistance of materials during sickness. The average duration of sickness is roughly estimated at about three weeks, the expenses occasioned by such sickness being from 2*s.* 6*d.* to 3*s.* per week. When, however, a casual pauper, by which term is to be understood a person not ordinarily in the custom of receiving relief, remains for any length of time upon the sick-list, he is brought before a Court of Governors, and transferred to the list of those who receive weekly pay. The pay-books for the past year exhibit a sum amounting to about 300*l.* on account of illness, and this includes relief to whole families on sickness overtaking the head of the family; the cases of sickness amongst casual paupers are registered as consisting of 108 persons (27 men, 44 women, and 37 children). Altogether, that is to say, amongst the casual and regular paupers of the city, about 6000 "cases" of sickness yearly present themselves; but then it must be borne in mind, that the same individual frequently constitutes two or more cases.

During the course of the past year, about 170 deaths chargeable upon the city took place, the majority of which were children; the cost of these amounted to 59*l.* 14*s.* 6*d.*, (coffins, 53*l.* 14*s.* 6*d.*, incidentals, 6*l.*,) making an average of about 7*s.* each for adults; however, the expenditure is above this average, their funerals being furnished under a contract of 9*s.* per funeral, (coffin, 6*s.*, grave 1*s.* 6*d.*, clergyman, 1*s.*, clerk, 6*d.*) This is, however, a much lower sum than is paid usually by those poor of the city who do not avail themselves of the public relief thus afforded, and even amongst the paupers themselves, a feeling of pride frequently interferes with an application for this purpose. Those who bury at their own expense pay on the average about 30*s.*, (coffin, 1*l.* 1*s.*, grave, 5*s.*, pall, 1*s.*, clergyman, 2*s.*, clerk, 1*s.*) The practice of both these classes is to keep their dead "too long" unburied, generally eight days; they make no difference between summer and winter; this is partly attributable to their practice of burying on the Sunday, and partly to the fact of an unburied body lying in the house being made the means of obtaining alms. The rooms often small, and occupied by a large family, where the corpses are retained, are offensive in the extreme; and the clergy and the undertakers complain much of the smells they are exposed to, especially in hot weather, from this practice.

On the occurrence of sickness the poor immediately apply for medical assistance, and this from various sources is freely rendered; the most prominent of which are the Medical Officers of the Corporation of the Poor, of the Hospital, Dispensary, Eye Infirmary, Lying-in Charity, and latterly by an extension of sick-clubs, more particularly that of the Odd Fellows. The Corporation of the poor provide four medical men, one of whom has the sole charge of the workhouse, and each of the others a third of the city; they are each paid a salary of 40*l.* per annum, and 7*l.* 7*s.* for vaccination, together with an allowance of 15*l.* a-year in lieu of drugs; beside this a small sum is occasionally received for suspended orders, at the present time amounting to almost nothing. By this means the Corporation of the Poor provide attendance in sickness for their own poor. Those not on the books of the Corporation are not considered as entitled to it; nevertheless it is often very freely granted to them. The Dispensary is a very popular and well-supported institution, and its object is to relieve those who are not absolutely paupers, but to whom the expense of procuring medical assistance is difficult. This institution is officered gratuitously, by six physicians and six surgeons, with a salaried dispenser. The building is capacious, and, perhaps, one of the best possibly adapted for such a purpose in the kingdom. The number of patients relieved annually at this institution amounts to about 2000; they attend at the institution weekly, and in cases of emergency are visited at their own houses during the space of six weeks. They are admitted by recommendations, of which four are allowed to each subscriber for each guinea subscribed. The average expenditure in medicine is found to be about 3*s.* 2*d.* per case. The Hospital, founded upwards of 100 years since, contains 200 beds; it is more a county than city institution; is officered gratuitously by four physicians and four surgeons, with a salaried resident apothecary and matron. It admits neither fevers nor contagious disorders. The average cost for medicine is about 5s. 3d. per case. This larger amount than that of the Dispensary is easily accounted for, by the Dispensary recommendations retaining a patient for six weeks only upon the books, so that during a long illness one person frequently enjoys the benefit of many admission tickets in the year, thus really consuming a much larger cost of medicines than the above average; whereas in the Hospital a recommendation is occupied by each patient without reference to time. The cost of medicines at these two institutions may be more clearly stated thus: the average per case at the Hospital is 5*s.* 3*d.*, and at the Dispensary six weeks' medicines amount to 3*s.* 2*d.* The Lying-in Charity affords limited relief to persons at their own houses; it provides, at the cost to each subscriber of half a guinea, a midwife, a basket of necessary child's and other linen, together with coal, candles, and materials for the diet of a lying-in woman; in cases of difficulty the medical officers, whether physicians or surgeons, assist. The statistics of this charity are interesting; the mean annual number of females assisted is 144, the ages of whom average 32½ years; the number of children already born to them amounts to 5·05, of whom 3·86 are reported as living. If to the children born the child that is to be produced by the same mother be added, the average is 6·05, a much larger proportion than can be contemplated as the real average of the city; but this may easily be accounted for by these women obtaining the charity from the circumstance of their being persons with large families, and by its not including those who never become mothers. It is the custom of this charity that the women report the result of their confinements; these reports, in 10 years, amounted to 836, the births attending which were 420 males and 416 females; of these 34 were still-births (1 in 24), an enormous proportion, arguing that those so poor as to require the benefit of the charity are much more liable to this casualty than women in a better station of life; nine were twin-births (1 in 93): of these two were girls, three were boys, two were boy and girl, and two were not reported.

The diseases incidental to this city present nothing very particular for observation; it is, indeed, remarkably free from any very distinctive character in this respect, the diseases consisting chiefly of the ordinary and less strongly-marked fevers, rheumatic affections, inflammations, and disorders of the great organs common to this country at large. It, however, seldom or never appears to enjoy any immunity from epidemic influence, when such is prevailing throughout the kingdom; and on occasion of infantile epidemics, usually suffers severely.

Having now set forth the influence of the local improvements of recent years on the population of Exeter, by comparing it with itself at different periods, we shall now proceed, in order more fully to estimate the value of these improvements, to compare the mortality incidental to it with that occurring in England and some of its chief cities.

An appreciation of the relative mortality of England and Exeter may be most satisfactorily arrived at, as tables of the mortality of both, founded on the double data of population and mortality, can be offered for comparison. The table of the mortality of England is deduced from the Life Table given by Mr. Farr in the Appendix to the Sixth Report of the Registrar-General; that of Exeter from the data now detailed.

Table XIX.—Number Living in Exeter at the undermentioned Ages, according to the Census of 1841.

—	Under 5.	5 under 10.	10 under 15.	15 under 20.	20 under 30.	30 under 40.	40 under 50.	50 under 60.	60 under 70.	70 under 80.	80 under 90.	90 under 100.
Males . . .	1702	1622	1506	1398	2371	2024	1413	893	557	260	45	6
Females . .	1801	1653	1484	1745	3624	2508	1868	1290	864	474	143	14
Total . .	3503	3275	2990	3143	5995	4532	3281	2183	1421	734	188	20

Table XX.—Average Annual Number of Deaths in Exeter at the undermentioned Ages.

—	Under 5.	5 under 10.	10 under 15.	15 under 20.	20 under 30.	30 under 40.	40 under 50.	50 under 60.	60 under 70.	70 under 80.	80 under 90.	90 under 100.
Males . . .	156·0	22·6	5·6	6·6	27·8	26·0	31·6	25·6	29·4	25·6	13·4	2·8
Females . .	141·2	19·6	6·6	8·8	27·2	27·0	23·8	24·0	35·6	42·8	26·8	4·6
Total . .	297·2	42·2	12·2	15·4	55·0	53·0	55·4	49·6	65·0	68·4	40·2	7·4

Table XXI.—The Numbers Dying per Cent. at the undermentioned Ages in Exeter and England. (The English Table taken from the Sixth Report of the Registrar-General.)

—	Males.		Females.		Total.	
	Exeter.	England.	Exeter.	England.	Exeter.	England.
Under 5	9·16	6·55	7·84	5·76	8·48	6·16
5 and under 10	1·39	0·99	1·18	0·99	1·28	0·99
10 ,, 15	0·37	0·56	0·44	0·56	0·40	0·56
15 ,, 20	0·47	0·73	0·51	0·78	0·48	0·76
20 ,, 30	1·17	0·88	0·75	0·91	0·91	0·90
30 ,, 40	1·28	1·14	1·07	1·12	1·16	1·13
40 ,, 50	2·23	1·48	1·27	1·36	1·68	1·42
50 ,, 60	2·86	2·12	1·86	1·87	2·27	2·05
60 ,, 70	5·27	4·40	4·12	3·98	4·57	4·16
70 ,, 80	9·84	9·03	9·02	8·32	9·31	8·64
80 ,, 90	29·77	17·45	18·74	16·38	21·38	16·95
90 ,, 100	46·66	30·83	32·85	29·88	37·00	30·04

This table shows that the mortality of Exeter is generally higher than that of England, excepting from the 10th to the 30th year of life; that male mortality is in excess at all ages excepting from the 10th to the 20th year, while female mortality is less than that of England from the 10th to the 60th year. Now, as the influence of locality, irrespective of employment, is far better appreciated from female than male death, we may fairly assume that though Exeter, as a city, is hostile to infancy, yet it is very favourable to adult and middle life: nor is there anything in the table to indicate it as uncongenial to advanced years. In fact, when it is borne in mind that the average mortality of England is much less than that of towns, we have every reason to assume that at this present time the population of Exeter is far from being oppressed by a high rate of mortality.

With regard to the excessive and undue rate of mortality under 10 years of age, it may be remembered that, in a previous page, this was shown not only to be proper to, but exclusively characteristic of, the poor district of the city. By this comparison of the mortality of Exeter with that of England, we again see, most strongly shown, that even the present amount of mortality is not dependent on its natural position, but is greatly due to the situation and attendant circumstances of the poor districts.

In the following table, compiled from local returns under the Registration Act, the mortality of Exeter is compared with that of some of the chief towns (not Registrar's districts) of England, in which, from recent observation, it appears there exists peculiar deficiency in many of the essential sanatory requisites.

TABLE XXII.—Showing the POPULATION and ANNUAL AVERAGE MORTALITY per Cent. of the Undernamed Places.

TOWNS.	Population, 1841.	Mortality.		
		Actual Average Annual.	Average Annual Per Cent.	One in every
Exeter	31,333	768	2·45	40·79
Worcester	27,130	684	2·52	39·66
Clifton (Parish)	14,177	362	2·55	39·16
Norwich	61,846	1,584	2·56	39·04
Birmingham	138,187	3,604	2·60	38·34
Leeds	168,667	4,487	2·66	37·59
Nottingham	53,080	1,444	2·72	36·75
York	29,329	799	2·72	36·70
Hull	41,130	1,156	2·81	35·57
Gloucester	14,869	423	2·84	35·15
Wolverhampton	68,425	2,002	2·92	34·17
Preston	50,131	1,488	2·96	33·69
Chester	23,814	729	3·06	32·66
Bristol	64,266	1,998	3·10	32·16
Manchester	192,408	6,153	3·19	31·27
Liverpool	223,054	7,811	3·50	28·55
Merthyr Tydvil	37,264	1,310	3·51	28·44

This table requires no very minute examination in order to show the point it is intended to indicate. It will be sufficient to observe, that as it exhibits the mortality of Exeter to be proportionably less than that of any of the other places, so does it offer, when the attendant circumstances of these several places are taken into consideration, conclusive evidence on the one hand of the baneful effects of the neglect, and on the other, of the beneficial effects of the improvement, of the sanatory condition of town populations.

We will now, however, take a more extended range of comparison, by selecting the 115 districts of the Quarterly Report of the Registrar-General, and comparing their mortality with that of Exeter, during the five years from 1838 to 1842. These districts comprise a population of 6,578,912, with an annual average amount of death of 163,968; so that they may be stated as liable to a mean mortality of 2·49 per cent., or of one death in every 40·1 persons. The lowest rate of mortality is 1·59 per cent., and the highest 3·36, showing a gross difference of 1·77 per cent. The average annual mortality of Exeter has been previously stated as 768, being 2·45 per cent., or one death in every 40·7 persons. We therefore see that the average annual mortality of Exeter, though not materially, is yet rather less than that of the whole 115 districts, and that it is below the mean of the highest and lowest recorded mortalities of the table.

In order to arrive at a satisfactory conclusion upon the relative situation of Exeter, as regards its mortality in respect to the districts of this return, it is necessary to analyze and suitably arrange them. It will be seen they not only include populations of very different characters, and subjected to very different influences, but frequently populations whose condition and character could not be inferred solely from the name by which they are designated. They will be found, on careful examination, to offer fair examples of the great masses of people common to this country, and may be arranged conveniently under the following heads:—

1. *Rural Districts*, in which the majority of the population are engaged purely in agricultural pursuits; 2. *Town and Rural Districts*, in which, though the mass of the people may be townspeople, its character is materially influenced by a large dilution of agriculturists; 3. *Town Districts;* 4. *Manufacturing;* and, 5., *Mining Districts;* in each of which the population is mainly of the character indicated by their respective names.

In accordance with this arrangement, the following table (XXIII.) is constructed. In it will be found distributed the whole of the 115 districts of the Quarterly Report previously referred to. It shows that a rural population, in accordance with the usual statement, enjoys a greater immunity from death than any of the other classes; that, as masses are congregated together, so is the rate of mortality increased; and that this increased rate of mortality is further augmented by local circumstances and specific employments, as indicated by the excessive mortality of certain of the town and manufacturing districts; we are therefore prepared to find that the rate of mortality in Exeter ranges higher than in the rural, or the town and rural districts; but that, in comparison with the manufacturing districts, as a whole, it is very favourably placed. If we view its position with regard to them individually, we observe but three which indicate a lower rate of mortality, and these will be found to contain populations of a mixed character. The purely and absolutely manufacturing districts (usually ill drained and ill supplied with water) are characterized by a much higher rate of mortality.

It now remains to consider what is the position of Exeter, in comparison with other districts somewhat of the same character. It will be seen that out of the 20 which compose the column of town districts, 11 are liable to a higher rate of mortality; viz., Derby, Worcester, south districts of London, Colchester, Shrewsbury, the central districts of London, Norwich, Leicester, Hull, Bristol, and Liverpool; on the other hand there are eight districts where the relative mortality is less, viz., Ipswich, Cambridge, west and north districts of London, Plymouth, Brighton, Oxford, and Yarmouth.

TABLE XXIII.—The DIVISIONS of the QUARTERLY TABLE arranged and their ANNUAL MORTALITY per Cent. shown.

RURAL DISTRICTS.	Population according to Census, of		Average Annual Mortality.		TOWN AND RURAL DISTRICTS.	Population according to Census, of		Average Annual Mortality.	
	Place.	Registrar's District.	Per Cent.	1 in		Place.	Registrar's District.	Per Cent.	1 in
Anglesey	50,891	38,105	1·59	61·8	Huddersfield	25,068	107,140	1·91	52·1
Isle of Wight	42,550	42,547	1·71	58·4	Lincoln	16,172	36,110	2·03	49·0
St. Thomas	4,301	47,105	1·81	55·0	Halifax	139,748	109,175	2·07	48·2
Dorchester	3,249	28,380	1·83	54·6	Basford	8,688	59,634	2·07	48·0
Penzance	8,578	50,100	1·88	53·0	Maidstone.	18,086	83,210	2·18	45·8
Windsor	7,528	20,502	1·89	52·8	Aston	45,718	50,928	2·19	46·6
Cockermouth	4,940	35,679	1·93	51·5	Cheltenham	31,411	40,221	2·19	45·4
St. Alban's	2,904	17,051	1·94	51·3	York	28,842	47,779	2·29	43·5
Stroud	8,680	38,920	1·97	50·6	Northampton	21,242	28,108	2·39	41·8
Newtown	3,990	25,958	1·98	50·3	Bradford	105,207	132,164	2·40	41·6
Holywell	10,834	40,787	2·00	49·9	Bath	38,304	69,232	2·44	40·9
Winchester	10,782	28,044	2·01	49·6	Great Boughton . . .	28,115	49,084	2·48	40·2
Devizes	4,631	22,130	2·07	48·1					
Kendall	10,225	34,694	2·12	47·1					
Bedford	9,178	31,767	2·15	46·4					
Clifton	14,177	66,233	2·18	45·7					
Wycombe	6,480	34,150	2·19	45·6					
Wrexham	12,921	39,542	2·19	45·5					
Hereford	10,921	33,646	2·23	44·7					
Portsea Isle	43,678	53,036	2·23	44·2					
West Derby	16,864	88,652	2·29	43·5					
Carlisle	23,012	36,084	2·36	42·3					
Abergavenny	4,953	50,834	2·47	40·3					
Mean Average . .	..	..	2·04	49·2	Mean Average . .	..	..	2·22	45·1

The Districts of the Quarterly Table arranged, and their Annual Mortality per Cent. shown—*continued.*

TOWN DISTRICTS.	Population, according to Census, of		Average Annual Mortality.		MANUFACTURING DISTRICTS.	Population, according to Census, of		Average Annual Mortality.	
	Place.	Registrar's District.	Per-Cent.	1 in		Place.	Registrar's District.	Per Cent.	1 in
Yarmouth	24,086	24,031	1·96	50·9	Kidderminster . . .	20,758	29,408	2·02	49·3
Oxford.	23,834	19,701	2·07	48·2	Walsall	20,852	34,274	2·35	42·4
Brighton	46,661	46,742	2·14	46·5	Prescott	35,902	43,739	2·37	42·0
Plymouth	37,058	36,527	2·27	43·9	Coventry	30,743	31,028	2·46	40·6
London, N. D.	366,303	366,303	2·30	43·3	Blackburn.	71,711	75,091	2·47	40·5
London, W. D. . . .	301,326	301,326	2·32	43·0	Wolstanton	16,575	32,669	2·48	40·2
Cambridge	24,453	24,453	2·35	42·4	Wolverhampton . . .	70,370	80,722	2·51	39·7
Ipswich	24,940	25,254	2·39	41·8	Rochdale	84,718	60,577	2·57	38·9
Exeter	31,312	31,333	2·45	40·7	Birmingham	138,215	138,187	2·60	38·5
Derby	32,741	35,015	2·47	40·3	Bury	62,125	77,496	2·61	38·3
Worcester	26,306	27,130	2·52	39·6	Wigan	51,988	66,032	2·62	38·2
London, S. D. . . .	479,469	479,469	2·53	39·3	Leeds	88,741	168,667	2·62	38·0
Colchester	17,790	17,790	2·54	39·3	Macclesfield	24,137	56,018	2·64	37·8
Shrewsbury	21,517	21,529	2·54	39·2	Preston	53,842	77,189	2·65	37·6
London, C. D. . . .	374,759	374,759	2·55	39·1	London, E. D. . . .	393,247	393,247	2·68	37·2
Norwich	62,344	61,846	2·56	39·0	Nottingham	53,091	53,080	2·72	36·7
Leicester	48,167	50,932	2·74	36·3	Stockport	84,282	85,672	2·73	36·6
Hull	41,629	41,130	2·81	35·5	Bolton	73,905	97,519	2·73	36·4
Bristol	140,158	64,298	2·96	33·7	Ashton	46,304	173,964	2·74	36·3
Liverpool	286,487	223,045	3·36	29·7	Sheffield	68,186	85,076	2·81	35·5
					Salford.	53,200	70,228	3·01	33·1
					Manchester	242,983	192,408	3·32	30·1
Mean Average . .	..	..	2·49	40·5	Mean Average . .	..	..	2·62	38·3

The Districts of the Quarterly Table arranged, and their Annual Mortality per Cent. shown—*continued.*

MINING DISTRICTS.	Population, according to Census, of		Average Annual Mortality.	
	Place.	Registrar's District.	Per Cent.	1 in
Chorlton and Worsley	93,736	93,736	1·98	50·2
Redruth	9,305	48,062	2·07	48·2
Tynemouth	27,249	55,625	2·26	44·1
Pontypool	2,865	25,037	2·34	42·5
Dudley	31,232	86,028	2·39	41·7
Gateshead	19,505	38,747	2·45	40·7
Merthyr Tydvil	34,977	52,864	2·59	38·5
Sunderland	17,022	56,226	2·62	38·0
Newcastle	49,860	71,850	2·71	36·8
Mean Average	..	..	2·37	42·3

Before, however, absolutely admitting this to be the case, the circumstances attending their different populations should be taken into consideration; for while there is nothing that can in any way indicate the statement of the mortality of Exeter to be undertold, that of some of these districts may fairly be assumed to be so. For instance, Oxford, Brighton, the west districts of London, and Cambridge, undoubtedly have a large amount of erratic population enumerated as belonging to them in the census of 1841; so that the mortality of these places is compared to a larger population than really supplies the deaths; and it is very questionable whether, as sea-ports, the same may not be said of Yarmouth and Plymouth. In this latter town the large amount of military stationed would alone throw discredit upon its being liable to so slight a mortality as the table indicates. Supposing, then, that the above-named places are not properly capable of being compared with Exeter, it would leave but two out of the town districts to be considered as subject to a less average mortality, the north districts of London and Ipswich. We may therefore fairly assume that Exeter, now that it is sewered and supplied with water, is not liable to a higher rate of mortality than is generally incident to favourably situated towns.

In a previous page (vide Table XII.), it was shown that the different districts of Exeter are subject to very different rates of mortality; by reference to the table just quoted, it will be seen that the "well-to-do" district has a less average than that of any of the districts of the Report; that the St. Sidwell and "mixed" districts are scarcely above the average of the rural districts, while the "poor" district is more than the average of the town, mining, or manufacturing districts. On taking a review of these, and the other facts set forth in the preceding pages, the following statements and conclusions may fairly be assumed:—

I. That the locality of Exeter is peculiarly healthy.

II. That Exeter, in common with other large cities, is liable to a greater amount of mortality than rural populations.

III. That the mortality of Exeter is very much in excess of that of the surrounding country.

IV. That when Exeter was unsewered, and ill-supplied with water, its mortality was as high as some of the now worst districts of England. ✓

V. That Exeter is now tolerably well sewered, and efficiently supplied with water.

VI. That Exeter is now subject to an infinitely less rate of mortality than cities whose sanatory condition has not been equally provided for. ✓

VII. That the average mortality of Exeter is less than that of the principal cities of England, and not greater than is generally incident to favourably situated towns.

VIII. That the adult population of Exeter is liable to a less rate of mortality than the average of England.

IX. That the different districts of Exeter present very different rates of mortality, those well ventilated, well sewered, and well supplied with water, being subject to less mortality than those not enjoying these advantages. ✓

X. That in these latter districts the amount of mortality under ten years of age is excessive. ✓

XI. That the former ancient excessive mortality was due to bad sewage and deficient supply of water, and that the modern less rate is entirely due to improvement in these respects.

XII. That as improvement in respect of sewage, &c., has progressed, so have the comforts of the inhabitants been enlarged, and their rate of existence prolonged.

XIII. That the rate of mortality in Exeter is much within the control of proper sanatory provisions, and that an extension of sanatory measures will decrease the present rate of mortality.

In order to follow out the purposes of this last conclusion, it is necessary to bear in mind that almost the sole aim of sanatory measures is the providing against and obviating the effects of a vitiated atmosphere; and, therefore the first duty in any inquiry of this nature is to ascertain where such sources of injuriousness prevail. From what has preceded, it will be seen that, as regards Exeter, the more active causes still in existence are the crowding of numbers in small and ill-ventilated rooms, the keeping of animals in confined situations, and the occasional prevalence of middensteads in private courts, and slaughter-houses, with their heaps of decayed offal. The passive causes may be stated as deficient ventilation, from the existence of blind courts and alleys; from the ill-arrangement of streets and the faulty construction of houses; from a partial deficiency of water, preventing the adequate removal of impurities; from neglect of house and street cleaning; and more particularly from deficient and imperfect drainage, owing to the occasional ill construction of private drains, and to the deficiency of stench-traps; likewise to the more general evil of the driving back of foul air from the great sewers, in consequence of the embouchures being exposed to the wind. The mere enumeration of these sources of bad air palpably indicates that, as far as possible, blind alleys and small courts should be abolished; that slaughter-houses, and the keeping of animals, should be prevented; that the streets should be opened to admit the free passage of air; that the houses should be constructed with a view to perfect ventilation, adequately supplied with water and with sinks, &c., for necessary purposes; that the drains communicating with the sewers, as well as the sewers themselves, should be well trapped and well constructed; that the embouchures of the latter should empty themselves below the level of the water, &c. The modes to be adopted for the prevention of the accumulation of bad air are, however, so obvious, that any lengthened discussion of them is quite unnecessary. I may, however, before concluding, venture to offer a few suggestions upon some matters, immediately connected with the subject, which present themselves.

1. As regards the Local Improvement Act,—it is almost absolutely necessary that some of its provisions should be extended, so that there may be a real and practical, instead of only apparent provision against private nuisances. The present requirement, that it must be "to the annoyance of any inhabitant," renders the clauses of the Act, in respect to these matters, effete; and that the provision for compelling private communication with the public sewers should be at the immediate expense of the proprietor instead of the occupier.

2. With regard to water;—as an ample and universal supply of this necessary of life is always to be desired, it would be a most useful measure if it were rendered obligatory on all householders to take it in. Such a regulation, while conducing to individual, would, by the refuse water, ensure greater public cleanliness, and in a monetary point of view, would perhaps, diminish its now low rate in this city to about one half. The income yielded by the present tenants amounts to about 4000*l.* per annum, made up by a charge of 1*s.* in the pound on the rateable value of the property to which it is supplied. Now, as the rateable property of the town is 133,448*l.*, it is evident that, were the principle of universal consumption adopted, 7*d.* in the pound would be sufficient to yield its present remunerating rental; but the real fact is, that an excess of income would be provided at this rate; for the property of the city has increased since this valuation was made, and moreover, the sphere of usefulness of the water company extends to wealthy suburbs, whose property is not included in the valuation of the city.

3. It was mentioned that the gradual increase of the town is depriving the inhabitants of long-accustomed bathing places; I would therefore suggest that proper and easily accessible river-bathing stations should be established; nor, as it is only during a short period of the year that the weather in this country permits cold open-air bathing, would the propriety of forming, on a large scale, tepid swimming tanks, or even warm baths, be unworthy of consideriaton. The main and only objection which presents itself to such a proposal is the expense; but this does not appear, from calculations laid before the Health of Towns Commission, so great as is generally supposed, (Rep. I., p. 313). The suggestion is hazarded, however, rather to excite inquiry than with any sanguine hope of seeing it carried into execution; not so, however, the provision for river bathing; this neither involves difficulty nor expense.

This Report must not be concluded without observing that an esteemed citizen of Exeter, J. Daw, Esq., about six months since, laid before the Commissioners of Improvement a very able statement connected with the public health of the city, in the course of which he directed attention to the excessive mortality which prevailed in 1841, as likewise from Michaelmas, 1843, to Lady Day, 1844, and showed most satisfactorily that this mortality had in a great measure taken place in localities which were characterised by circumstances of deficient sanatory police; for that this undue mortality not only followed the lines of the uncovered drains in the outskirts of the town, but was found in the vicinity of slaughter-houses, pigsties, &c. Mr. Daw's statements on these matters were so lucid and conclusive, that the Commissioners immediately responded to his appeal. The drains complained of are now covered over; a stricter police is being established as regards the more private infractions of sanatory regulations; and in order the more effectually to follow up these and other necessary measures connected with the public health of the city, the Commissioners have appointed a committee of their body, under the designation of the Sanatory Committee, whose sole duty is to carry out such provisions of their Act as relate to it. This committee is now actively employed in giving their attention to many of the points above enumerated.

Communication from T. Hawksley, Esq., of Nottingham, explanatory of some Passages in his Evidence relating to the Size and Construction of Sewers.

Sir, Nottingham, July 15, 1845.

In compliance with your wishes, I have the honour to transmit, in explanation of part of the evidence given by me before the Health of Towns Commission, a short abstract of some of the principal results of my experiments and investigations concerning the discharge of water in *pipes*, *rivers*, and *sewers*, and the requisite magnitude of artificial *water-courses*. To this I have appended three very easily applied tables, for the use of practical men.

I am, Sir,
Your most obedient servant,
T. Hawksley.

H. Hobhouse, Esq.,
&c. &c. &c.

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1. The fundamental proposition from which all inquiries into the circumstances affecting the flow of water must proceed is simply this, that *when the motion is uniform, the forces and the resistances are equal.*

Now, the resistance which water experiences in moving with uniform velocity along a uniform channel of considerable magnitude arises almost entirely from the friction, or rather impact, of the particles against those portions of the channel with which they come in contact, and the effect of that resistance must necessarily be spread over, and be divided amongst, the whole number of filaments set in motion by the operating force.

In a cylindrical pipe, the surface of contact is $= \pi d l$ (where $\pi = 3\cdot1416$, $d =$ the diameter in inches, and $l =$ the length in inches) and the corresponding number of filaments is as $\frac{\pi d^2}{4}$, consequently the resistance due to these circumstances is as

$$\frac{\pi d l}{\frac{\pi d^2}{4}} = \frac{4\,l}{d}$$

The resistance arising from the collision of the particles against the sides of the pipes is manifestly as the square of the velocity (v); the total resistance is therefore as $\frac{4\,l\,v^2}{d}$, and putting (a) for a constant number to be determined by experiment, we obtain for the value of the resistance (r)

$$r = \frac{4\,a\,l\,v^2}{d}$$

The force which occasions the motion, and overcomes the resistance, is familiarly representable by a perpendicular column or head of water pressing on the mouth of a filled pipe. Call this head, in inches, (h). When the column is not in motion the head exerts a pressure exactly proportionate to its height; but when the water begins to flow a certain portion of this pressure is removed. The pressure thus lost is in the case of a pipe flowing full equal to $\frac{v^2}{515}$, the velocity being measured in inches per second. Consequently, the force (f) which remains to counterpoise the resistance (r) is equal to $h - \frac{v^2}{515}$.

Now making, according to our fundamental proposition, $f = r$, we obtain

$$h - \frac{v^2}{515} = \frac{4alv^2}{d}.$$

And, by experiment on *large* PIPES,

$$a = \frac{1}{112000}.$$

Consequently, $v = \sqrt{\frac{515hd}{\frac{l}{54} + d}}$, an equation applicable to *pipes* from which any one of the four variable quantities may be determined when the other three are given.

But with regard to *sewers*, it must be remarked that the streams by which they are fed should be made to flow in the direction of the established current, with a velocity at least equal to that which obtains in the sewers—the equation then becomes

$$h = \frac{4alv^2}{d} = \frac{4lv^2}{112000d},$$

$$\text{and hence } v = \sqrt{\frac{28000hd}{l}},$$

Now the quantity of water discharged in each minute in cubic feet is

$$\frac{60 \times \cdot 7854\, d^2}{1728}\, v = q;$$

$$\therefore \text{ finally, } q = \frac{60 \times \cdot 7854\, d^2}{1728}\sqrt{\frac{28000hd}{l}};$$

$$= 4\cdot 564\sqrt{\frac{hd^5}{l}}.$$

But it is very convenient to consider $\frac{h}{l}$ as a declivity. Let, therefore, the declivity be 1 in n, then $\frac{h}{l} = \frac{1}{n}$ and the equation becomes

$$q = 4\cdot 564\sqrt{\frac{d^5}{n}} \quad . \; . \; . \; (A);$$

$$\text{whence } d = \left(\frac{q^2 n}{20\cdot 84}\right)^{\frac{1}{5}} \quad . \; . \; . \; (B);$$

$$\text{and} \quad n = \frac{20\cdot 84\, d^5}{q^2} \quad . \; . \; . \; . \; (C).$$

In this form the equation contains only three variable quantities, the useful results are therefore capable of being exhibited in a tabular statement for practical application (see Table No. 1), and they are most easily obtained from the equivalent logarithmic form of the equation (A)

$$\log. q = \frac{5 \log. d - \log. n}{2} + \cdot 6594.$$

2. It is essentially necessary to know not only the quantity of water which can be discharged, but also the area from which that quantity of water will be derived.

During a violent thunder storm which recently occurred in Nottingham, and which in consequence of the inadequacy of the sewers inundated the lower parts of the town, $\frac{7}{8}$ths of an inch of rain were observed to fall in something less than half an hour, and this depth, about two inches per hour, very nearly corresponds with the maximum fall observed by Mr. Roe in London. The hourly fall upon one acre of ground is therefore $\frac{4840 \times 9 \times 2}{12} = 7260$ cubic feet, which is very nearly equivalent to 120 cubic feet per minute.

In town districts, which are roofed and paved, about $\frac{5}{6}$ths of the rain will, after the first few minutes, run off the surface as fast as it falls. The sewers must therefore be provided of a magnitude sufficient to discharge in each minute a number of cubic feet of water, equal to 100 multiplied by the number of acres in the natural urban area of drainage.

It sometimes happens that the natural area is partly urban and partly rural. In the rural district the land is generally under cultivation, and consequently the water is partly absorbed, and is likewise partly detained in cavities. Moreover its passage to the sewers is always more or less delayed, according to the nature of the soil and the inclination of the ground; and it may further be observed, that very violent rains are rarely in this climate of long duration. With respect to the rural portion of the district, it will therefore generally be sufficient to assume, where the country is *hilly*, a flow to the sewers in one minute of about 50 cubic feet per acre, and where the country is *slightly inclined* a flow of about 25 cubic feet per acre.

3. With the above values of (q) we are enabled to determine the magnitude of any cylindrical or nearly cylindrical sewer; but as it frequently happens that the stream has to be conveyed, especially in outfalls, through channels of very dissimilar figures, some of which may be *closed* and others *open*, the subject will not be practically complete unless we obtain an equation of general applicability.

Reasoning as before, the resistance of a channel of irregular form is manifestly directly as the extent of the rubbing surface, directly as the square of the velocity, and inversely as the area of the transverse section.

Let (m) represent the girt of so much of the margin of the section as is in contact with the stream, and let (s) represent the transverse area of the stream. Then when the velocity is uniform,

$$h = a\, l\, v^2 \frac{m}{s};$$

And since $a = \frac{1}{112000}$

$$h = \frac{l v^2 m}{112000\, s}$$

$$\text{Whence } v = \sqrt{\frac{112000\, h\, s}{l\, m}}$$

And again substituting for $\frac{h}{l}$ its equivalent $\frac{1}{n}$,

$$\text{we obtain finally } v = \sqrt{\frac{112000\, s}{m\, n}} = 334\sqrt{\frac{s}{m\, n}} \quad . \; . \; . \; (\text{D}).$$

But the quantity of water (q) discharged in each minute is in cubic feet $= \frac{60\, s}{1728} . v$

$$\therefore q = \frac{60\, s}{1728}\sqrt{\frac{112000\, s}{m\, n}} = 11{\cdot}6\sqrt{\frac{s}{m\, n}}$$

$$\text{And } n = \frac{135\, s^3}{m\, q^2}.$$

These equations contain four variable qualities, and consequently the results do not admit of arrangement in a single Table.

We may however assume in the equation (D) that

$$m : s :: 1 : p$$

$$\text{or } \frac{s}{m} = p.$$

$$\text{Consequently } v = 334\sqrt{\frac{p}{n}} \quad . \; . \; . \; (\text{E}).$$

$$p = \frac{n\, v^2}{112000} \quad . \; . \; . \; . \; . \; (\text{F}).$$

$$n = \frac{112000\, p}{v^2} \quad . \; . \; . \; . \; . \; (\text{G}).$$

equations which admit of tabulation on one form; see Table No. 2.

4. The Table No. 1 resolves, by a single inspection, all questions which are likely to arise respecting the proper magnitude of town sewers of a *cylindrical* shape, but this shape is not the most proper for ordinary sewers. During dry weather the stream through the sewer consists, in general, of no more than the waste water of houses, though sometimes to this may be added the injection water of engines and the drainage from manufactories. Commonly, however, the stream is so much spread in a sewer of the cylindrical shape, that it moves along very sluggishly, and consequently deposits in its course most of the filth and detritus which have been brought in from the minor drains and gully-holes. A stratum of solid matter, therefore, speedily forms at the bottom of the sewer, which stratum is continually increasing and continually indurating, till at length the sewer becomes so much obstructed as either to be no longer capable of passing the produce of ordinary rains, or otherwise of

receiving the water from the domestic drains. The sewer has then to be broken open for the performance of a noisome, expensive, and unhealthy operation of manual cleansing, only to be again from time to time repeated. Now our equations show that velocity is gained as the stream is made to assume a more compact section, for the velocity is always as $\sqrt{\frac{s}{m}}$, and we know also that the ability to scour increases in a much higher ratio, namely, as the *square* of the velocity; it is therefore of much consequence to add even a trifle to the velocity when the discharge is small, by adopting for our sewer a section of such figure that, while it shall not seriously depart from the strong and otherwise advantageous form of the circle, shall at the same time considerably diminish the denominator m when the stream is diminutive. It is also desirable that the sewers thus formed should be comparable with each other, be of easy construction, easily calculated, and easily repaired. The egg-shaped oval, of which examples are annexed, is on these accounts to be commended.

The area of this oval is

$$\cdot7854\left(\frac{d^2}{2}+\frac{(2\,d)^2}{8}.\ 2+\frac{(\cdot293\times2\,d)^2}{4}-\frac{(\cdot707\,d)^2}{2}\right)=\cdot996\,d^2$$

or, its area is very nearly equal to the square of its horizontal diameter.

And its internal periphery is

$$3\cdot1416\left(\frac{d}{2}+\frac{2\,d}{8}\cdot2+\frac{\cdot293\times2\,d}{4}\right)=3\cdot6\,d$$

or its internal periphery is 3·6 times its horizontal diameter.

$$\text{Moreover } \frac{s}{m}=\frac{\cdot996\,d^2}{3\cdot6\,d}=\frac{d}{3\cdot6}$$

$$\text{But in a circular sewer } \frac{s}{m}=\frac{d}{4}$$

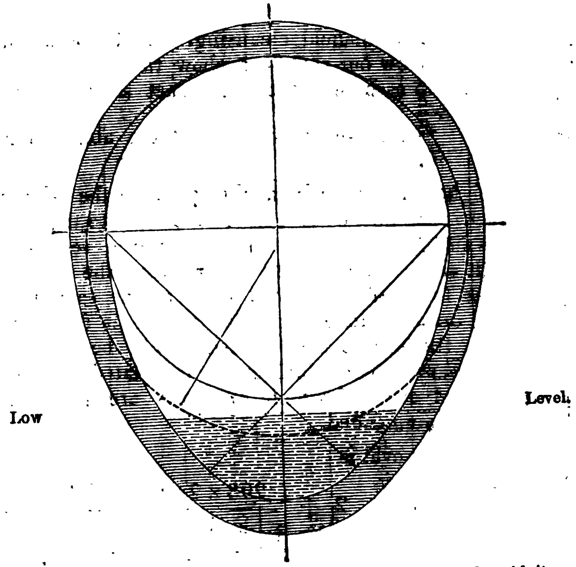
$\therefore$ since $v\ a\ \sqrt{\frac{s}{m}}$ the velocity in an oval sewer is to the velocity in a circular sewer as $\frac{\sqrt{d}}{1\cdot9} : \frac{\sqrt{d}}{2} :: 20 : 19$, and the cleansing effect as 10 : 9.

When the two descriptions of sewers are of the same diameter, the area of the oval sewer is to the area of the circular sewer as 996 to 785 = 1·27 to 1; $\therefore$ when the areas are equal the diameters will be as 8 to 9 nearly. And hence we have these convenient rules for determining the magnitude and power of *oval sewers.*

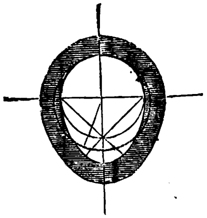
1. *Find in the Table the diameter of the circular sewer capable of affording the requisite amount of drainage. Deduct its ninth part. The remainder is the horizontal diameter of the equivalent oval sewer which is to be constructed in the manner shown by the lines on the figure.*

2. *Add one-eighth to the diameter of an oval sewer. The sum is the diameter of the equivalent circular sewer, the discharge, declivity, and drainage area of which may be found in the Table.*

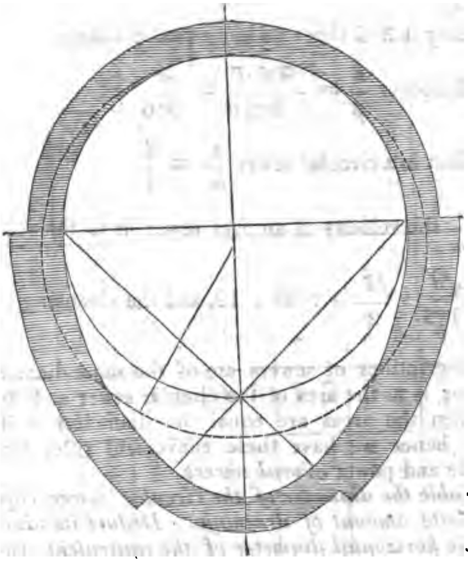
8-feet circle, with its equivalent oval sewer, supposed to be formed in firm ground.



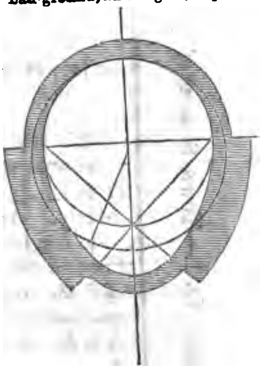
2-feet circle, with its equivalent oval sewer.



The same, formed in bad ground.



4-feet circle, and its equivalent oval sewer, supposed to be formed in bad ground, and at great depth.



The dotted lines show the circle on which the ovals are founded.

TABLE No. 1.—TOWN SEWERS of cylindrical figure; exhibiting the Diameters, Declivities, Discharges, and Number of Acres in the Area drained.

Declivities, or Rates of Inclination.	Diameter of Sewer.														
	6 Inches	9 Inches	12 Inches	15 Inches	18 Inches	24 Inches	30 Inches.	36 Inches.	48 Inches.	60 Inches.	72 Inches.	84 Inches.	96 Inches.	108 Inches.	120 Inches.
1 in 10 .	127 1·3	351 3·5	720 7·2	1,258 12·6	1,985 20·0	4,072 40·7	7,114 71·1	11,220 112	23,030 230	40,260 403	63,460 634	93,350 933	130,300 1,303	175,000 1,750	227,700 2,277
1 in 20 .	90·0 0·9	248 2·5	509 5·1	889 8·9	1,403 14·0	2,880 28·8	5,029 50·3	7,936 79·4	16,290 163	28,470 285	44,880 449	66,010 660	92,170 922	123,700 1,247	161,000 1,610
1 in 30 .	73·5 0·7	203 2·0	416 4·2	725 7·3	1,146 11·4	2,352 23·5	4,107 41·1	6,480 64·8	13,290 133	23,230 232	36,650 367	53,910 539	75,260 753	101,000 1,010	131,400 1,314
1 in 40 .	63·5 0·6	175 1·8	360 3·6	629 6·3	992 9·9	2,036 20·3	3,557 35·6	5,610 56·1	11,515 115	20,130 201	31,730 317	46,675 467	65,150 652	87,500 875	113,850 1,139
1 in 50 .	56·9 0·6	157 1·6	322 3·2	562 5·6	887 8·9	1,822 18·2	3,181 31·8	5,018 50·2	10,300 103	18,010 180	28,390 284	41,750 418	58,290 583	78,230 782	101,800 1,018
1 in 60 .	52·0 0·5	143 1·4	294 2·9	514 5·1	810 8·1	1,663 16·6	2,904 29·0	4,581 45·8	9,406 94·1	16,440 164	25,800 258	38,110 381	53,210 532	72,070 721	92,960 930
1 in 80 .	45·0 0·5	124 1·2	254 2·5	444 4·4	701 7·0	1,440 14·4	2,515 25·2	3,968 39·7	8,145 81·5	14,235 142	22,440 224	33,005 330	46,085 461	61,850 619	80,500 805
1 in 100 .	40·3 0·4	111 1·1	227 2·3	397 4·0	629 6·3	1,288 12·9	2,257 22·6	3,549 35·5	7,285 72·9	12,740 127	20,040 200	29,520 295	41,220 412	55,330 553	72,010 720

1 in 120 .	36·7 0·4	101 1·0	208 2·1	362 3·6	573 5·7	1,176 11·8	2,053 20·5	3,240 32·4	6,645 66·4	11,615 116	18,325 183	26,955 270	37,630 376	50,500 505	65,700 657
1 in 160 .	31·7 0·3	87·5 0·9	180 1·8	314 3·1	496 5·0	1,018 10·2	1,778 17·8	2,805 28·1	5,757 57·6	10,065 101	15,865 159	23,337 233	32,575 326	43,750 438	56,925 569
1 in 200 .	28·4 0·3	78·5 0·8	161 1·6	281 2·8	443 4·4	911 9·1	1,590 15·9	2,509 25·1	5,150 51·5	9,005 90·1	14,195 142	20,875 209	29,145 291	39,115 391	50,900 509
1 in 240 .	26·0 0·3	71·5 0·7	147 1·5	257 2·6	405 4·1	831 8·3	1,452 14·6	2,290 22·9	4,703 47·0	8,220 82·2	12,900 129	19,055 191	26,605 266	36,035 360	46,480 465
1 in 320 .	22·5 0·2	62·0 0·6	127 1·3	222 2·2	350 3·5	720 7·2	1,257 12·6	1,984 19·8	4,072 40·7	7,117 71·2	11,220 112	16,502 165	23,042 230	30,925 309	40,250 403
1 in 400 .	20·1 0·2	55·5 0·6	113 1·1	198 2·0	319 3·2	644 6·4	1,128 11·3	1,774 17·7	3,642 36·4	6,370 63·7	10,020 100	14,710 147	20,610 206	27,665 277	36,005 360
1 in 480 .	18·3 0·2	50·5 0·5	104 1·0	181 1·8	286 2·9	588 5·9	1,026 10·3	1,620 16·2	3,322 33·2	5,807 58·1	9,162 91·6	13,472 135	18,815 188	25,250 253	32,850 329
1 in 640 .	15·8 0·2	43·7 0·4	90·0 0·9	157 1·6	248 2·5	509 5·1	889 8·9	1,402 14·0	2,878 28·8	5,032 50·3	7,932 79·3	11,668 117	16,287 163	21,875 219	28,462 285
1 in 800 .	14·2 0·1	39·2 0·4	80·5 0·8	140 1·4	221 2·2	455 4·6	795 8·0	1,254 12·6	2,575 25·8	4,502 45·0	7,097 71·0	10,437 104	14,572 146	19,557 196	25,450 255

The upper figures in each square denote the number of cubic feet of water discharged per minute.

The lower figures in each square denote the number of acres in the area drained.

In a hilly *rural* district the number of acres will be double the number given in the Table, and in a flatter *rural* district the number will be four times that given in the Table.

TABLE No. 2.—Applicable to SEWERS, RIVERS, PIPES, and WATER-COURSES of any Figure, Regular or Irregular, exhibiting the DECLIVITIES and VELOCITIES (in inches per second), corresponding to various values of p $\left(= \frac{s}{m} \text{ in the equation } v = 334\sqrt{\frac{p}{n}}\right)$

Rate of Inclination or Declivity, (1 in n.)	Values of $p = \frac{s}{m}$, s and m being taken in inches.									
	1	2	4	8	16	32	64	128	256	512
1 in 9 . .	111	157	222	315	445	630	890	1260	1781	2519
1 in 16. .	83	118	167	236	334	472	669	945	1338	1889
1 in 25. .	66	94	133	189	267	378	535	756	1069	1511
1 in 36. .	55	78	111	157	222	315	445	630	891	1260
1 in 49. .	47	67	95	135	190	270	381	540	763	1080
1 in 64. .	41	59	83	118	167	236	334	472	668	945
1 in 81. .	37	52	74	105	148	210	297	420	594	840
1 in 100 .	33	47	66	94	133	189	267	378	534	756
1 in 144 .	27	39	55	78	111	157	222	315	445	630
1 in 225 .	22	31	44	63	89	126	178	252	356	504
1 in 324 .	18	26	37	52	74	105	148	210	297	420
1 in 441 .	15	22	31	45	63	90	127	180	254	360
1 in 576 .	13	19	27	39	55	78	111	157	223	315
1 in 729 .	12	17	24	35	49	70	99	140	198	280
1 in 900 .	11	15	22	31	44	63	89	126	178	252
1 in 1600 .	8·0	11	16	23	33	47	66	95	133	189
1 in 2500 .	6·5	9	13	19	26	38	53	76	107	151
1 in 3600 .	5·5	7·5	11	15	22	31	44	63	89	126
1 in 4900 .	4·7	6·5	9·5	13	19	27	38	54	76	108
1 in 6400 .	4·0	5·5	8·0	11	16	23	33	47	67	94
1 in 8100 .	3·5	5·	7·0	10	14	21	29	42	59	84
1 in 10,000	3·2	4·5	6·5	9·5	13	19	26	38	53	76

Example 1. What is the necessary diameter of an oval sewer to drain a town district of 50 acres, the attainable declivity being 1 in 50?

Answer. The Table gives the diameter of a circular sewer = 36 inches. The horizontal diameter of the oval sewer is therefore $36 - \frac{36}{9} = 32$ inches.

Example 2. What area will an oval sewer of 92 inches diameter effectually drain, the fall being only 1 in 100?

Answer. $96 + \frac{96}{8} = 108$ inches is the diameter of the equivalent circular sewer, which sewer it appears by the Table would, under the *worst* circumstances, drain 553 acres of town area, 830 acres of precipitous rural area, or 1106 acres of a moderately inclined rural district.

5. The Table No. 2 is capable of very extensive application, since by its use we may determine the magnitude and declivity of a sewer, pipe, river, canal, or other water-course to effect a certain performance; we may determine the velocity of a stream and the stability of its bed; we may assign the contraction to be given to a harbour to enable the current to accomplish the requisite amount of scour; we may assign the proportions of the drains in fen levels; we may conduct water by gravitation along conduits or aqueducts for the supply of towns, and do all these and many other things of equal importance, without guessing at results and without wasting the capital of the proprietor; with proper modifications it is also applicable to the various cases of land and agricultural drainage.*

Example 1. Mr. Watt measured a canal 18 feet wide at the surface, 7 feet wide at the bottom, and 4 feet deep; the declivity was 1 in 16000, the mean velocity = 14 inches nearly.

In this example $\frac{s}{m} = p = 29$, which is not to be found in the table, neither is the declivity 1 in 16000, but $p = 32$ and 1 in 8100 are both to be found; in the column headed 32 we find opposite 1 in 8100 a velocity = 21, and $32 - 29 = 3$ is $\frac{1}{5}$ of the difference between 32 and 16, $\therefore \frac{21 - 14}{5} = 1 \cdot 4$ has to be deducted from 21, leaving 19·6 for the velocity corresponding to a fall of 1 in 8100, and $\frac{19 \cdot 6}{\sqrt{8100 \times 2}} = 14$ inches, the velocity corresponding to a fall of 1 in 16000, as was found by actual experiment. Calculating from the formula $\left(v = 334 \sqrt{\frac{p}{n}}\right)$, the result is 14·2 inches.

Example 2. Monsieur Couplet experimented on the discharge of a large pipe at Versailles, the diameter was 19·2 inches, the virtual descent 1 in 300, the velocity = 42 inches nearly.

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* In all *important* cases not included in the Table, the calculations should be made immediately from the formulæ.

Here $\frac{s}{m} = 4\cdot8$. Looking along the line 1 in 324, we have under $\frac{s}{m} = 4$, a result $= 37$ inches. Add $\frac{1}{10}$ of 37 for the difference between $\frac{s}{m} = 4$ and $\frac{s}{m} = 8$. This gives $v = 40\cdot7$, add $\frac{1}{26}$th $= 1\cdot6$ for the difference of the declivity, and the result is 42·3 inches. By the formula $v = 41\cdot8$ inches.

Example 3. The Italian river Rheno is stated to be 189 feet wide and 9 feet deep, and it has a declivity of 1 in 4200, what is the velocity?

$$\text{In this instance } s = 189 \times 9 \times 12^2,$$

$$\text{and } (\textit{probably})\ m \doteq 200 \times 12,$$

$$\therefore \frac{s}{m} = p = 100 \text{ nearly.}$$

And averaging as before $v = 51$ inches nearly, which is a few inches greater than the recorded velocity, as in fact it *ought to be*, from the defective character of the experiment, in which the stated velocity (44 inches) was derived from the time (12 hours) occupied by the passage of a fresh through a distance of 30 miles.

The velocity of the important river, the Po Grande, was found to be 55 inches; from an assumed value of p, which is almost certainly too great, we determine the velocity $= 60$ inches, quite sufficiently near for practical purposes.

6. When the discharge and the declivity are alone given, as most commonly happens in practice, it is difficult to determine the dimensions of an irregular water-course. The best mode of proceeding is, first to ascertain, from Table No. 1, the area of the circular sewer, which would perform the required work. Then assume the intended water-course to have a nearly rectangular margin. We know that the velocity is proportionate to $\sqrt{\frac{s}{m}}$; in the circular sewer $\frac{s}{m} = \sqrt{\frac{d}{4}}$, and in the rectangular open water-course $\frac{s}{m} = \sqrt{\frac{b\,\delta}{b + 2\,\delta}}$, in which b is the breadth and δ the depth.

The area must obviously be increased as the velocity is diminished by increasing the quantity $\sqrt{\frac{s}{m}}$, and it must diminish as $\sqrt{\frac{s}{m}}$ increases, for otherwise the discharges would not be equal. Therefore, with respect to the new area,

$$b\,\delta = \cdot7854\, d^2 \sqrt{\frac{\frac{d}{4}}{\frac{b\,\delta}{b + 2\,\delta}}};$$

$$\therefore \sqrt{\frac{b^3 \delta^3}{b + 2\delta}} = \cdot 4 \sqrt{d^5}.$$

Now assume that the breadth of the water-course shall be to its depth as $k : 1$;

$$\therefore b : \delta :: k : 1.$$

$$\text{Whence } b = k\,\delta;$$

$$\therefore \frac{k^3 \delta^6}{k\,\delta + 2\,\delta} = \frac{k^3 \delta^5}{k + 2} = \cdot 16 \delta^5.$$

And, consequently,

$$\text{The depth } \delta = \cdot 7\, d \sqrt[5]{\frac{k+2}{k^3}}.$$

$$\text{The breadth } b = k\,\delta = \cdot 7\, d \sqrt[5]{\frac{k+2}{k^3}} \times k.$$

Example. It is required to determine the size of a large open water-course, with nearly upright sides, the area to be drained containing about 2000 acres of land; namely, 300 acres of town area, 800 acres of flat rural district, and 900 acres of hilly country, the declivity of the water-course being 1 in 100.

These areas are equivalent to

Town area		= 300 acres.
Rural district . . .	$\frac{800}{4}$	= 200 „
Hill country	$\frac{860}{2}$	= 430 „
Tabular Total . .		= 930 „

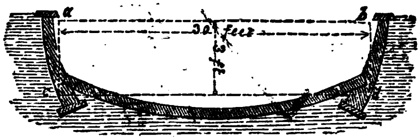
By inspection of the Table No. 1, I determine the diameter of a circular sewer, capable of effecting this service, to be 120 inches, = 10 feet. I am prevented by local difficulties from making a deep cutting, and I am therefore induced to assume that the breadth shall be 10 times the width, $\therefore k = 10$, the equation therefore becomes

$$\delta = \cdot 7\, d \sqrt[5]{\frac{k+2}{k^3}} = \cdot 7 \times 10 \times \sqrt[5]{\frac{10+2}{1000}} = 3 \text{ feet}$$

= the depth required.

And $b = k\,\delta = 3 \times 10 = 30$ feet = the width required.

With these dimensions I construct a rectangle as follows:—



And upon that rectangle arrange the outline of the water-course, so that without disturbing the value of $\sqrt{\frac{s}{m}}$, I may nevertheless obtain *strength of form*, *economy of construction*, and *power to scour when the water is low.*

7. It now only remains shortly to notice the rules to be observed in proportioning the thickness of street sewers. In firm ground the principal pressure arises from the weight of the incumbent earth, and in even semifluid ground this perpendicular pressure cannot be exceeded by the pressure on any other part of the sewer, for if it were the sewer would be displaced and actually floated up to the surface. Now a brick of fair average quality will support *without crushing* a column of soil at least 600 or 700 feet high. It is also known that good hydraulic mortar, especially if mixed with about $\frac{1}{5}$th of Roman cement and a sufficient quantity of sharp river sand, will be equally strong. The practice of a long period of years has decided that a permanent strain upon brick-work ought not to exceed about $\frac{1}{4}$th of the crushing force. Let (t) be the thickness of the work, (r) the radius of curvature, and D the depth above the crown at which the sewer is to be constructed, we then obtain $\frac{160\,t}{r + t} = D$, and from this equation we have formed the following Table:—

Table No. 3.—Showing the *Maximum* Depth at which it is safe to Construct Sewers, with the undermentioned Radii of Curvature and thicknesses of Brick-work.

Radius of Curvature.	½ Brick.	1 Brick.	1½ Brick.	2 Bricks.	2½ Bricks.
Feet.					
1	44				
2	25				
3	18	32			
4	..	25			
5	..	22			
6	..	18	25		
7	..	15	22		
8	..	14	20	25	
9	..	12	18	23	
10	..	..	16	21	
11	..	..	15	19	23
12	..	..	14	18	22

If the earth be firm and sound, the thickness of the sides of an oval sewer need not be greater than that of the crown. If the earth be soft and moist, the sides must be one-half thicker than the crown; and if the earth be semifluid, or liable to become so, or be quick-sand, or soft London clay (such, for instance, as has been met with in several railway cuttings, where it has run itself out to a slope of 6 to 1), then the thickness of the sides must not be less than that due to the radius with which they are struck.

Example 1. A *circular* sewer of 8 feet diameter has to be made at a depth of 20 feet, what must be its least thickness?—In the

Table, opposite the radius 4 feet, is placed the nearest depth = 25 feet, over which is the thickness = 1 brick.

Example 2. What is the thickness of the equivalent *oval* sewer, the soil being wet and nearly semifluid?—*Answer*. The diameter of the equivalent oval sewer is only 7 feet. The radius of the crown is therefore 3½ feet, and the radius of the sides 7 feet. From the Table, I find the thickness of the crown = 1 brick, and the thickness of the sides = 1½ brick.

In sound earth (which presses perpendicularly), the top of the sewer ought, instead of being a semicircle, to be an arch of equilibrium. It is, however, but little necessary to attend to this correction, inasmuch as the friction and cohesiveness of the incumbent earth are always sufficient to prevent the haunches from being forced up by the pressure on the crown.

The strengths given by the Table suppose an amount of attention to the "backing and filling" which there is too much reason to fear this description of work seldom receives. The quality of the mortar is also frequently neglected, as well as the joining-up of one length of work to another. It is, therefore, by no means surprising that many sewers have failed, and that it has, in consequence, become almost a custom to employ a strength, and incur an expense, far beyond those which are absolutely necessary. The result of the existing deficiency of principle in design, and neglect of attention in execution, has led to endeavours to diminish the cost by diminishing the extent and magnitude of the work. Hence nearly all our sewers, and especially those more important adits which receive and discharge the waters of extensive and populous cities, are, almost without exception, too small for their intended purposes. They act well enough, it is true, on ordinary occasions; but, upon occasion of those immense falls of rain with which we are visited every two or three years, they almost invariably become gorged, and hence fearfully inundate the lower neighbourhoods. The Romans, possessing little or none of our scientific knowledge, nevertheless understood the uses and value of sewers much better than we do. Rome was effectually contoured, and every hill possessed its separate cloaca, of great size, into which the minor drains separately entered, and these principal cloacæ again discharged their accumulated contents into the "cloaca maxima," a sunk sewer, of not less than 15 paces in diameter. Such also was the importance which the Romans attached to the subject of drainage, that they even enacted a general law, entitled the "Servitus cloacæ," under which sewers could be taken through private property, whenever needful for the public benefit. With the moderns, however, immediate pecuniary economy is everything; money is habitually considered and valued *per se*, without reference to its utility in procuring health, education, or comfort, and hence ill-contrived, badly-executed, and scarcely-remediable works are continually forced upon the country, in defiance of a multiplied experience of their ultimate insufficiency, in order that some present outlay, or, perhaps, a trifling amount of salary may be avoided.

One of the most singular instances of this prevalent folly is now in existence at Nottingham. Some years ago the authorities found it needful to inclose an open brook-course, into which the drainage of about 150 acres of town area, and probably 600 acres of a somewhat precipitous rural district ran. The diameter of the sewer, which is circular, was, from motives of economy, restricted to about 4 feet; now, from our Tables, it appears that the proper diameter of an *oval* sewer, on a declivity of 1 in 80, is, for effecting this extent of drainage, somewhere about 8 feet. The consequence of this deficiency of magnitude is exactly what might have been anticipated. The sewer, incapable of conveying its burden, discharges its water with great violence through the gully-holes, and thereby inundates the houses in its course, occasioning not only damage to property, but also alarm, discomfort, and serious loss of health to the inhabitants. As the same authorities have also suffered this sewer to be built upon by the adjacent house-owners, so that its effectual improvement under any existing powers is wholly impossible, there is probably no case on record which more clearly demonstrates the impropriety of entrusting scientific management in the hands of an incompetent, irresponsible, and unpermanent local administration, than the one to which the attention of the Commission is now solicited.

T. H.

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